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Determinants of Rural Households' Off-farm Employment Participation and Income in Rural Tigray: Evidence from Endamokonni and Degua Tembien Woredas of Tigray Region, Ethiopia

By

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DECLARATION

This is to certify that this MSc. thesis entitled "Determinants of rural households' off-farm employment participation and income in rural Tigray: Evidence from Endamokonni and Degua Tembien Woredas" submitted in partial fulfillment of the award of degree of Master of Science in Economics to the School of Graduate Studies, Mekelle University, through the Department of Economics done by Mr.Haile Tewele Berhe is an authentic work carried out by him under our guidance. The matter embodied in this project work has not been submitted earlier for award of any Degree or Diploma to the best of our Knowledge and belief.

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Abstract

This study examines the determinants of off-farm employment participation and income of rural households in rural Tigray, using evidence from Endamokonni and Degua Tembien Woredas of Tigray region, Northern Ethiopia.

Results are based on data collected from a survey of 205 randomly selected rural households. Both bivariate probit and univariate probit models are used to estimate the off-farm wage and off-farm self employment participation. Given participation, the factors that affect per capita off-farm employment income are analyzed using two step Heckman selection model. This considers for possible self selection in the estimation procedure.

Age and formal education of the household head, number of children with 10 years old or under and district where the households live significantly affects participation in off-farm wage work. On the contrary, participation in off-farm self employment is strongly determined by sex of the household head, number of adult male in the household, per capita non labor income, credit use, per capita livestock holding, district and distance to the nearest all weather road and distance to the nearest major market.

Households with large farm size, informally educated heads and those who live in Endamokonni Woreda earn significantly higher income from wage work. Households with older heads, more adult males, more children with five years old or under, higher livestock holding and those who live far-off from major market earns lower off-farm wage income, in case they participate. Given participation, male headed families earn higher income from off-farm self employment than the female headed counterparts. Number of adult male and children with six to ten years old in the family negatively and significantly relates with the level of per capita self employment income. This may be because off-farm self employment income is expressed in per capita terms.

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List of Abbreviations and Acronyms

CSA	Central Statistics Agency
DFID	Department for International Development
EDRI	Ethiopian Development Research Institute
ESSP	Ethiopia Strategy Support Program
IFPRI	International Food Policy Research Institute
ILO	International Labour Organization
KM	Kilometers
NGO	Non-Government Organizations
OLS	Ordinary Least Squares
TLU	Tropical Livestock Units
&	And
%	Percent

CHAPTER ONE

1. INTRODUCTION

1.1. Background of the Study

Development policies of rural sector have often targeted in improving farm productivity to combat the major economic problems like rural poverty, food insecurity and inequality among the rural families. However, there is growing evidence that the rural sector is more than farming in developing countries. The rural economy is not based solely on agriculture but also on a diverse array of off-farm employment activities (Reardon, Berdegue & Escobar, 2001). Off-farm employment is very broad concept. Generally it consists of wage employment and self-employment activities that earn income in return to the households' labor supplied outside their own farm. Wage employment includes paid development work, farm wage, skilled and unskilled regular wage (salary) employment and casual daily works. Self-employment comprises selling firewood and charcoal, stone mining, grain and livestock trading, petty trading, weaving, mat making, pottery and handcraft etc. Households may also get incomes outside the farm and/or off-farm employment sources of income which we referred as the non-labor income. It includes remittance income received from relatives and friends not presently living with the household, from pension, gifts, renting out assets, inheritances and government aids.

Wide range of literatures from developing countries has identified the significant role of off-farm employment on reducing rural poverty, inequality, and income vulnerability. In Latin America for example, rural households earn 40-45% of their income from nonfarm sources (Reardon et al., 2001). Moreover, several studies in Africa have reported that off-farm earnings account for a substantial share of farm households' income. According to Haggblade, Hazell, and Reardon (2007), off-farm employment income account for about 35% of rural incomes in Africa. Okali, Okpara, and Olawoye (2001); DFID (2004) and Oluwatayo (2009), suggested that income from household members' participation in non-farm activities has been contributing significantly to farm households' welfare in Nigeria. DFID (2004) has reported that as much as 60% of farm household's income in Nigeria derives from off-farm activities. The situation is likely to be

similar in other countries of sub-Saharan Africa, except the result from Tanzania where share of off-farm income to total income of rural farm households is only 8% (Mduma &Wobst, 2005). Similar result is also found in Ethiopia. Davis (2003) on his study of "rural non-farm economy, livelihoods and their diversification: issues and options", has reported that some 20 percent income of rural households in Ethiopia originates from nonfarm sources. Similarly, Hagos and Holden (2003) in their study in northern Ethiopia have documented per capita off-farm income accounts for about 34 percent of households' per capita consumption expenditure. The study conducted by Nigisti (2007) in the northern Ethiopia (Tigray) also reported that the relatively better-off rural households drive 6% of their income from wage employment and 13% from self employment while the poor households derive 40% of their income from wage employment income and 10% from Self-employment income sources. This implies that, off-farm employment income, in spite of its significant contribution to the total income of rural households' in Ethiopia, its benefit for the relatively rich and poor rural households is not the same.

The motivations of farm families for off-farm labor employment may differ across geographical areas, communities and households. For some households it is due to the existence of thin or missing credit markets in which case off-farm earnings can be a crucial means of overcoming working capital constraints. That is, to purchase necessary variable in puts for farming (e.g., fertilizer, seeds, equipment, labor) or to make capital improvements (e.g., building house, ridge and irrigation etc). On the other hand, farm cash income may not be sufficient to satisfy the households' cash requirements (for taxes, consumption goods purchases, school fees, medicines, etc).In this case also, off-farm earnings may be essential to finance the family cash requirement (Reardon, Barrett, Kelly,&Savadogo,1999; Savadogo, Reardon, & Pietola,1998).When agriculture becomes risky, farmers need to reduce income and consumption variability by engaging in off-farm employment activities which have low or negative correlation with returns to agriculture (Barrett, Reardon, &Webb, 2001).

In Ethiopia, agriculture is highly dependent on rainfall; hence, rainfall rules the lives of many rural families. It determines whether they will have enough to eat and be able to provide basic necessities and earn a living. Indeed, the dependence on rainfall and its erratic pattern has largely contributed to the food shortages that farmers are often faced with. Devereux, 2000 argue that

even in good years, the one-time harvest or crop may be too little to meet the yearly household needs; as a result, many rural families in Ethiopia remain food insecure (as cited in Bezabih et al., 2010, p.3). In their study of participation in off-farm employment, rain fall patterns and rate of time preference in Ethiopia, Bezabih et al. (2010) showed that off-farm activities could serve as an adaptation options to climate change.

In general, the rationale for farm households income diversification in to off-farm activities arises basically from low and /or unstable returns to productive assets like labor, land or livestock, from market failures (e.g., for credit and insurance), from ex ante risk management and ex post coping with adverse shocks (Barrett et al., 2001). Household members may also motivate to enter the off-farm labor market to earn high incomes from the off-farm sector (Babatunde, Olagunju, Fakayode, & Adejobi, 2010). Thus, the driving forces for farm households to engage in off-farm activities are different.

However, households could fail to participate in off-farm activities due to some barriers like high entry costs, low education levels and limited access to information (Woldehanna &Oskam, 2001). Where markets do not operate in a competitive way, personal and institutional constraints play an important role in determining participation in off-farm activities (Reardon et al., 1998). Household wealth, private and public asset endowments and regional characteristics (e.g. agro climate) can also play a critical role as they may enhance or hinder the profitability of the household endowment base (Escobal, 2001).In addition, Bezabih et al.(2010) have found from Amhara regional state, Ethiopia that weather shocks as measured by availability and variability of rain fall have a significant effect on the participation of households in off-farm activities. From this we understand that there are different incentives and constraints that affect farm households' decision to participate in off-farm activities. These factors that could affect participation in off-farm activities could be individual, household, social and communal based. Farm households sell labour for off-farm work at the market wage rate. The market wage rate in turn depends on the marketable human capital such as education, skill and experience, gender and age, and household characteristics like family size and number of dependants, land size and other household assets, as well as, communal assets like electricity, access roads and other assets (Woldehanna, 2000; Schwarze, 2004).

1.2. Statement of the Problem

Some studies, for example Freese (2010) in Burkina Faso, Raphael and Matin (2010) and Idowu, Awoyemi, Omonona, and Falusi (2011) in rural Nigeria, Mduma and Wobst (2005) in Tanzania, have documented the driving forces of off-farm labor participation. Woldehana and Oskam (2001) have also analyzed the interaction between farm and non-farm activities, in Ethiopia. In spite of the few studies which analyze the driving forces for off-farm work participation and its impact on reducing economic problems like poverty, inequality, vulnerability etc. Yet studies which examine determinants of off-farm work participation and income of rural households in Tigray are scarce.

In most of the rural areas of Tigray rural families are characterized by less fertile and small per capita agricultural land ownership. Besides, they use almost static agricultural technologies and obtain low agricultural yield (Yesuf &Pender, 2005; Woldehanna, 2000). Thus, income earned from agriculture alone could not satisfy the needs of rural households in Tigray and in the study Woredas as well.

It is apparent that off-farm employment could help to absorb rural household's surplus labor and enhance family income and food security. In their study of off-farm employment participation in Tigray Woldehanna and Oskam (2001) have reported that farmers in Tigray involves in various off-farm activities such as working for wage, petty trading, weaving, mat making, pottery and handcraft, sale of firewood and charcoal, stone mining, grain and livestock trade etc. This implies that rural households in Tigray often involve in different off-farm activities outside their farm. However, it is not surprising to find households that do not involve in any activity outside their farm. Besides, those who participate may not equally reap the benefit from off-farm work. Thus, it needs an investigation to identify the factors that lead to this participation and off-farm income differences among farm households. To fill this knowledge gap it needs to be backed up with research. Hence, this study will address the potential incentives that promote household's participation and the constraints or barriers that hinder participation in off-farm activities. It will also try to identify the potential constraints and opportunities among the participant rural households to benefit from certain off-farm activities. In general, there exists little empirical

evidence related to the determinants of off-farm employment participation and corresponding income of rural households. Addressing the factors that affect households' participation in some off-farm employment activities and incomes from them will serve as a source of information for policy makers, administrators and donors in general, and benefit the rural households in particular.

1.3. Research Objectives

The general objective of the study is to analyze the determinants of off-farm employment participation and income of rural households in Tigray.

1.3.1. Specific Objectives

The specific objectives of the study are to:

- Describe and characterize the livelihood activities of the study area
- Analyze the determinants of off-farm employment participation
- Identify factors that affect the amount of income earned from off-farm work

1.4. Research Questions

At the end, this paper will try to answer the following research questions:

(i) Does off-farm employment income equally important for the relatively rich and poor farmers?

(ii) Which variables determine participation in off-farm employment of the rural farm households in the study area?

(iii) Do factors that affect off-farm employment participation can also affect the level of income from off-farm employment?

1.5. Significance of the Study

The study is significant for it increases individuals' understanding regarding the factors that influence farm household's participation in off-farm employment and corresponding benefits obtained from them and the importance of off-farm employment incomes across the different

income groups. The outcome of this study could also be use full for local administrators and NGOs in order to devise interventions that could improve the livelihoods of the rural poor. Particularly this paper could serve as a source of reliable information for farmers and policy makers regarding the actions that should be undertaken so as to improve households' participation in different off-farm employment activities and incomes earned from them. The findings could also use as reference for researchers who are interested to conduct further study on the field.

1.6. Scope and limitation of the Study

The study has undertaken in the south eastern and southern zones of Tigray, Degua Tembien and Endamokoni Woredas. That is, due to the existence of resource and time constraints the study is confined to these areas only. Among all other options of rural households' livelihood strategies, the scope of this study is mainly limited to off-farm employment in the two Woredas. Since farmers do not keep records and due to mind lapse, we face difficulty to get exact values for some questions.

1.7. Organization of the study

The remaining part of this paper is organized as follows. Chapter two presents the literature review which deals with the theoretical and empirical review of off-farm employment participation and income from off-farm activities. Chapter three presents the data source, methodology and model specification. In this chapter the description of the study area, the sources of data, the methods used to obtain the data and the theoretical and econometric models used for analyzing the data set are presented. The analysis of empirical results are presented and discussed in chapter four. The last chapter is the conclusion and recommendation part of the study.

CHAPTER TWO

2. LITERATURE REVIEW

2.1. Definition of Terms and Concepts

Off-farm employment: defined as activities from which the farmers earn income apart from their farm work. It may include agricultural wage work on other people's farm, non-agricultural wage-employment or self-employment in commerce, mining, manufacturing, transport, and services sector. Thus, unlike non-farm employment off-farm employment, is broader concept used to denote all works (agricultural or non agricultural) performed outside the own farm.

Non-farm employment: includes all activities other than agricultural work at the own farm and labor on another farm from which the farmers earn income.

Off-farm income: is the income earned from all sources excluded the income from the household's own farm or rented in plot.

Farm income**:** is the income from the farm households own farm or rented in plot, which includes net income from crops and animals.

Crop income: is obtained by subtracting gross costs from the volume harvested times median sales prices at the regional level.

Livestock income: consists of net income from sold live animals and both consumed and sold raw animal products, such as meat, eggs, milk, skin etc. Net livestock income is obtained by subtracting gross production expenditure from the quantity of animals sold times producer median prices and the quantity of produced raw animal products time's consumer median prices in the relevant region.

Household income: consists of all receipts in cash, in kind or in services that are received by the household or by individual members of the household at annual or more frequent intervals, but excludes windfall gains and other such irregular and typically one-time receipts (ILO, 2003). It is

the sum of off-farm employment income, farm income, and non-labor income from rented out assets, remittance, inheritance, social benefits, and net transfers.
Participation: the act of taking part or sharing in some activities.

Household: is defined in this research as people living under the same roof and eating food from the same pot. That is, a household member who did not live independently during the survey time at least for six months.

Rural: is any locality that exists primarily to serve agricultural hinterland.

Rural household: is a household that lives in the countryside and that may involve in both farm and off-farm activities.

Woreda: is an administrative unit greater than tabia and equivalent to district.

Tabia: is the lowest administrative unit of settled rural area.

2.2. Theoretical Model

The basis for the household's participation decision is the theory of agricultural household model, where the household has a dual role of producer and consumer. If markets are perfect, the household first maximizes profit by choosing different sets of income generating activities based on its resources and prices, and then maximizes utility by choosing between different levels of consumption and leisure given profits. However, in case the markets are imperfect production and consumption decisions become non-separable (Bardhan & Udry, 1999).

In case markets for labor are assumed perfect, rational individuals will choose to participate in off-farm work over staying working on their land as long as their marginal value of farm labor (reservation wage) is less than the off-farm wage rate (Brick, Garvey, &Cuddy, 2005). If this is true thus, poor households have higher incentive to diversify into off-farm activities because they earn a lower marginal value of farm labor. The reservation wage is defined as the marginal value of an individual's time when he/she allocates all of his/her time to farm/home time (and zero to off-farm work). The basic model as adapted from those presented in Brick (2005); Brick, Garvey, and Cuddy (2005); Huffman and El-Osta (1998) with some adjustment is presented here under.

$W_{ri} = r_i (W_f, P_f, P_h, V_i, H_f, H_h, Z_{hi}, T_i)$

$W_{ofi} = W_{ofi} (H_{of}, L_{of}, Z_{of})$

Where W_{ri} is reservation wage, W_{of} off-farm wage and i refers to the i th individual

W_f = input price vector

P_f = price of farm output

P_h = price of purchased consumptive goods

Z_{hi}= other characteristics,

V_i = unearned income e.g. grants, subsidies, remittance, property income

H_f=farming related human capital

T_i=household member's endowment of time

H_{hi}= Household members human capital variables of e.g. education, work experience

Off-farm wage depends on individual human capital (H_{of}) location characteristics (L_{of}) and other job related characteristics (Z_{of}). For a dummy D_i, D_i =1 for participation in off-farm work and D_i =0 other wise, Pr (D_i=1) = Pr (W_{ri}<W_{ofi}).

$$D_i = \begin{cases} 1 \text{ if } (W_{ri} < W_{ofi}) \\ \\ 0 \text{ if } (W_{ri} > W_{ofi}), \end{cases} \qquad \text{(i)}$$

Where Pr (.), represents the probability of participating in off-farm work, thus, the probability of an individual's participating in off-farm work depends on all the exogenous variables that enter individual's reservation wage equations. Variables that raise the reservation wage reduce the probability of off-farm work, and variables that raise the off-farm wage offer increase the probability of off-farm work. For variables that raise both the reservation wage and wage offer, the net effect on the probability of off-farm work is, priorily uncertain. However, with imperfect labor and credit markets and where transaction costs are involved in the labor input and output markets farmers may not participate in the off-farm labor even if the reservation wage rate is less than the marginal value of labor (Woldehanna, 2000). Moreover, mobility barriers within the rural non-farm sector limit the poorly endowed households from accessing high return non-farm activities (Barrett et al., 2001). In the real labor market, which is characterized by rationing and

lack of jobs outside farm, it is hard to get perfect markets for labor. Reardon1997 argued that the actual participation of farmers in off-farm activities depends on the incentive and the capacity to participate (as cited in Reardon et al., 2001).

2.3. Livelihood Diversification: Conceptual Foundation

Different terms such as off-farm, on-farm and non-farm are used to show diversification of activities and incomes. According to Barrett and Reardon (2000), the rural households activities and the corresponding income can be grouped using a three-way classification by sector (e.g., farm versus non-farm), function (wage versus self-employment), and space (local versus migratory).

The classification of activities based on sector follows the distinctions of national accounting systems as primary (agriculture, mining, and other extractive activities), secondary (manufacturing), and tertiary (services). This leads directly to the distinction between agricultural or farm income and non-agricultural or non-farm income. Hence, It does not matter where the activity takes place (on the farm premises, in town or abroad), at what scale (in a huge factory or by a single person), with what technology, or whether the participant earns profit or labor income (wages or salary) from the activity (Barrett *et al.*, 2001).

The second is functional classification. This includes wage employment (i.e., involving in wage or salary contract) and self employment (e.g., entrepreneurial activity).

Given the sectoral and functional classification of an activity, the third one is spatial classification (local and migratory) which in turn holds some important sub categories (Barrett & Reardon, 2000; Barrett *et al.*, 2001). Local activities are divided in to two sub categories (i) “at home or on-farm” (ii) “local away from home or off-farm”. On the other hand, migratory or “distant away from home” activities can be categorized further in to: (a) domestic rural (e.g., inter-zone migration), (b) domestic urban (such as to a distant metropolitan area), and (c) foreign. From the three-ways of classification presented above, this study emphasis on spatial classification (on-farm/off-farm type).

People in most part of the world (rural or urban) diversify their income. They collect their income from different sources, hold their wealth in different assets or use their assets in more than one activity. Before, we try to state the rationale for households livelihood diversification it is better to define what income diversification refers to. The definition for income diversification differs among authors. Ersado (2003) defined income diversification as an increase in the number of sources of income or the balance among the different sources. Delgado and Siamwalla (1997) defined diversification as the switch from subsistence food production to the commercial agriculture. Others authors for example, Escobal (2001) define income diversification as an expansion in the importance of non-farm income. This definition of income diversification is linked to the concept of structural transformation at the national level, defined as the long term decline in the percentage contribution of agriculture sector to gross domestic product (GDP) and employment in growing economies. Income diversification can also be defined as the process of switching from low value crop production to higher value crops, livestock, and nonfarm activities. Thus, many analysis of income consider income diversification as strategies employed to earn cash income in addition to primary production activities from a variety of sources (Dercon & Krishnan, 1996).

The United Kingdom Department of Foreign and International Development (DFID) (2004) incorporate "a livelihood" which comprises the capabilities, assets and activities required for a means of living. Livelihood diversification thus, refers to attempts by individuals and households to find new ways to raise income and reduce risk, which differ by the freedom of choice. Livelihood diversification includes both on-farm and off-farm activities which are undertaken to generate income additional to that from the main household agricultural activities, via the production of other agricultural and nonagricultural goods and services, the sale of wage labor or self-employment and other strategies to spread risk (Oluwatayo, 2009).

2.4. Empirical Literature Review

In this section some studies that deal with off-farm or non-farm employment participation decision and earnings from those activities are reviewed.

Having seen the basic classifications of incomes and activities, and the definitions of livelihood diversification above, the reasons why households and individuals do diversify their income are presented below. Mostly the question, why do rural households diversify their livelihoods arises on livelihood studies. Barrett and Reardon (2000) have attempted to answer for this question on their study of income diversification and household livelihood diversification strategies in rural Africa. They stated that farm household diversification in to nonfarm activities emerge from diminishing or time-varying returns to factors of production, from market failures (e.g. for credit) or frictions (e.g. for mobility or entry into high-return niches), from ex ante risk management, and from ex post coping with adverse shocks. Where returns to productive assets (e.g. land, labor or livestock) vary across time or among individuals within a household or households within a community, individuals, or households will diversify their assets, activities and incomes.

In addition, incomplete markets (e.g. for land, labor, credit, or insurance) may induce farm households to diversify their livelihood. For example, a smallholder household endowed with much labor but relatively little land will in the absence of well-functioning land markets hence apply some labor to its own farm and hire some labor out for off-farm wage employment in agriculture. Because when individuals or households are not endowed with the ratio that maximizes returns and there are not well-developed asset markets through which they can exchange assets to achieve the optimal mix, diversification becomes the usual response. Similarly, where markets for credit or insurance are incomplete, individuals are typically unable to smooth consumption even they desire credit to smooth the production or income variability. For many institutional, infrastructural, technological, and informational reasons, financial markets are usually incomplete in rural Africa. So, individuals must act outside of financial markets in order to reduce consumption variability driven by real income variability. Diversification is a primary means by which many individuals reduce risk (Barrett et.al, 2001).

On the contrary, missing markets can discourage diversification. According to Reardon 1997missing credit markets can hinder diversification into activities or assets characterized by substantial barriers to entry (as cited in Reardon et al., 2001). On the other hand, if off-farm options can be accessed easily, but credit markets are incomplete, non-farm earnings can be a crucial means for overcoming working capital constraints to purchasing necessary variable inputs

for farming (e.g. fertilizer, seeds, equipment, labor) or to make capital improvements (e.g. bunds, ridges, irrigation) to one's farm (Woldehanna & Oskam, 2001).

Diversification also serves as a copping response for ex post shocks. When crops fail or livestock die, households must reallocate labor to other pursuits, whether formal off-farm employment (e.g. wage labor), informal off-farm employment (e.g. hunting), or non agricultural activities (e.g. weaving and brewing). One implication of diversification as risk management rationale is that the need for self-insurance is a function of the availability of substitute social insurance, provided through transfers by the government, by non-profit organizations, by community or family members. Since social insurance can at least partly substitute for self insurance, one would expect greater need for asset, activity, and income diversification where social insurance is relatively scarce. This might be indicate by the high dependence of African farm households on non-farm income, as governments, communities, and relief agencies offer meager and frequently slow safety nets, and the social foundations of traditional safety nets appears to be stretched (Barrett et.al, 2001;Ellis,2000).

De Janvry and Sadoulet (2001) have used a multinomial estimation to analyze the determinants of participation in off-farm activities using Mexican ejido level data. They documented that the effect of individual characteristics, for instance, the presence of adult males of less than 35 years old have higher probability of participation in off-farm activities than do the household heads. Females at all age levels have lower probability participation in off-farm activities than the head of the household. Regarding the effect of education, they found that households with 9 or more average years of schooling have higher likelihood of participation over those with less than three years. Greater access to land and ethnicity (defined as speaking indigenous language) reduces participation in off-farm wage work. Location, defined as the number of urban centers within one hour of travel by public transport makes no difference across all individuals, but increases females participation in non agricultural wage labor while decreasing participation in agricultural wage labor. They also reported that low access of land, human capital, migration assets and ethnicity play negative role on non-agricultural income.

Atamanov (2011) on his study made in Kyrgyz republic has tried to identify the determinants of individual participation in pure non-farm and a mixture of farm and non-farm activities based on a multinomial logit regression analysis (where pure agricultural activities is the choice comparison). Results show that push factors like availability of small land size and poor land quality make individuals choose non-farm activities over agricultural activities. The negative influence of age of the household head and number cattle are also an indication of push factors. But, he found also some indication of pull factors, for example, the marginal increase in land owned by the household (denoted by land owned square), decreases probability of participation in non-farm activities at a decreasing rate, indicating that there may be less incentive for those with ample access for land to divert from non-farm activities. The study tries also to show the determinants of participation non-farm activities by disaggregating in to self-employment, employment by private organizations, public organizations and by individuals. Gender has different effect across the non-farm activities. Women are likely to engage in public non-farm organizations, while men are more likely to employ by private organizations and individuals. Education is found to have a significant effect to be employed by public and private organizations unlike for self-employment and employment by individuals. He tried also to estimate the determinants of non-farm earnings using double hurdle model for the participant households. Age increases the level of non-farm earnings from public and private organizations but doesn't affect the level of income from self-employment. Males reap high-income form both wage and self-employment activities than their female counterparts. Education positively affects non-farm income, even for self-employment income, where education does not affect participation in self-employment. Access to infrastructure and market characteristics also increases level of earning from wage and self-employment activities. Asset ownership in the form of livestock increases significantly earnings from non-farm activities.

Ibekwe, Eze, Ohajianya, Orebiyi, Onyemauwa, and Korie (2010) have reported a result that supports the distress diversification hypothesis, for they found a negative relationship between nonfarm-income and the farm output per hectare of land using a survey data from south east Nigeria. The study tries also to show the effect of other variables like education, age of the household head, farm size, household size and farm investment. Education of the head has

positive and significant effect on the level of non-farm income at 5% significant level. The variables like farm size, household size and farm investment have a negative and significant correlation with non-farm income. The coefficient for age of the household head was not significant and negatively correlated with non-farm income.

Regarding to the income diversification of the farm households, studies found that the existence of substantial entry or mobility barriers (particularly in labor market and financial and credit) to high return niches within non-farm economy make the poor to have less diversified asset and income portfolio and enter only into less remunerative activities (Barrett, Bezuneh, & Aboud, 2001; Barrett & Reardon, 2000). Barrett et al (2001) has extended and explains the difference in income portfolios and livelihood diversification pattern are associated with labor market segmentation, barrier to entry, location and potential income growth.

Oluwatayo (2009) has made similar study on poverty and income diversification among households in rural Nigeria. Tobit regression model has used to show the determinants of livelihood diversification. Male headed, small sized family, non-poor households with formal education and better income and access to credit facility were affect the livelihood index positively. Besides, Determinants of income share from different sources of non-farm activities among rural households in the same country has explored by other group of researchers (Olugbenga, Adewunmi, John & Adebayo, 2011). The study indicates that education, experience in any non-farm activity and distance to urban center were the major determinants of income shares from different sources of non-farm activities.

Evidence from rural areas of Tanzania shows the determinants of off-farm wage work participation(defined by the number of households who supply labor to the rural local market) and share of labor income in total cash income (Muduma & Wobst,2005). The study finds that education level, availability of land, access to economic centers and credit are the most important factors in determining the number of households that participate in a particular rural local labor market and share of labor income in total cash income.

The factors that influence labor supply, labor demand and household members' choice between farm and off-farm work were also determined among smallholder farmers in three regions of

southern Uganda (Bagamba, Burger & Kuyvenhoven, 2007). Results on the time allocation decisions revealed that farm size had a significant negative effect on the amount of labor supplied to off-farm work; which is consistent with the assertion that farmers seek off-farm employment due to push factors .The results also confirmed that factors such as education and road access, which improve the opportunity cost of labor in the off-farm sector, affect positively the amount of time allocated in off-farm activities. This implies that investment in education and road infrastructure would favor the off-farm sector against on-farm employment. Men would benefit most from development of the off-farm sector, as most of the household individuals employed in the sector are men.

Freese (2010) has documented finding from Burkina Faso which are consistent to the results found from other sub-Sahara African countries. The empirical paper uses Heckman two-step selection model to determine the probability of participation and level of income generated in the non-farm sector. The regressions are applied to the pooled data, as well as the wealthiest and poorest expenditure quintiles respectively. The result shows having male headed households and more adult male members decreases the probability of participation in non- farm sector for the poorest quintiles. Household size increases the likelihood to participate in the non-farm sector for the pooled data. Education variables influence participation positively for the pooled data and wealthiest households as well. Interestingly, education of the household head does not affect significantly participation in non-farm sector for the poorest quintiles. Distance to local public infrastructure (as measured by distance to secondary school, health center and market) negatively significantly affects participation. The analysis shows also education and proximity to community structure positively and significantly affects income from non-farm activities for the wealthier quintile and pool data. For the poorest households only, distance to health centers, household age and number of adults influence the success in non-farm earnings.

Lanjouw and Murgai (2008), were analyzed the role of agricultural wages and non-farm employment using a panel data in India. According to this literature expansion of the non-farm sector is associated with falling poverty in two ways: a direct impact on poverty that is, likely due to a pro poor marginal incidence of nonfarm employment expansion; and an indirect impact attributable to the positive effect of non- farm employment growth on agricultural wages.

The recent literature on off-farm labor market participation by Babatunde and Matin (2010) in rural Nigeria have described the composition of average household income. It tries also to analyze the determinants of participation in off-farm labor employment and incomes from them. The literature shows 50 percent of household income is derived from off-farm sources. Off-farm self-employment and non-agricultural wage employment accounts 25% and 6% of total household income respectively. They applied multivariate probit model to estimate the determinants of participation in different off-farm employment activities. Education of both the household head and other adults, availability agricultural and non-agricultural machinery, access to electricity and water and households headed by male positively and significantly affects off-farm employment participation. Distance to market and family size on the other hand significantly hinders participation. The results from the multivariate probit model indicate that households headed by male have high probability of participation in agricultural and non-agricultural wage employment but is insignificant for self employment. Education of the household head and other adults, positively affects non-farm wage and self-employment activities. But, agricultural wage negatively and significantly affected by education of other adults. Household assets, access to electricity and pipe water encourage self-employment, where as market distance affects negatively. Farm size does not show any significant effect across all off-farm activities. Tobit model has been used to estimate the determinants of income from off-farm involvement. The result indicates family size and land size have positive effect on the level of off-farm income. Exceptional negative effect of family size is reported for self-employed and remittance incomes.

2.4.1. Empirical Literature from Ethiopia

Evidence from Tigray implies participation in off-farm work uses both as ex ant and ex post strategy to reduce household's income variability which a raise from variation and shortage of rain fall (Nigisti, 2007). The finding of her literature shows that household wealth denoted by the value of large livestock and amount of cultivated land negatively affects off-farm work participation. Age of household head and family size significantly influences participation, but the effect for education and labor saving technology proxy by price of pesticides and herbicides has found insignificant.

Similarly Bezabih et al., (2010) have also documented the determinants of off-farm employment and activity choice between agriculture and three other non-farm activities in Amhara regional state, Ethiopia using a two year panel data. They found that amount of rain fall decreases participation in off-farm work but the variability in rain fall promotes participation. This is in line with the argument that off-farm employment serves as agricultural risk mitigation strategy. The result shows households with large male and female labor participate more in off-farm employment. But older household heads are less likely to participate. Presence too large or no land motivates off-farm participation. Ownership of livestock has also a significant and positive effect on the likelihood of households of off-farm employment participation.

Berg and Kumbi (2006) have used a multivariate probit model to estimate the relation between poverty and participation in non-farm sector in Oromia region, Ethiopia. Non-farm activities were disaggregated in to three: hand crafts, food and drink and trade. Their result indicates, own cultivated land, which represents for rural households productive asset has a negative and significant effect on participation across the three non-farm activities. This implies the relatively poor households are more likely to be engaged in non-farm sector. Households owning more pack animals are likely to participate in non-farm activities. Positive and significant effect of family size and negative effect of dependency ratio on the likelihood of taking part in food/drink activities shows that nonfarm activities are used surplus labor from agriculture. Age, experience and primary education positively affects participation in hand craft. While informal education affects positively participation in food/drink and trade. The effect of distance to all weather roads is positive for handcrafts and negative for food/drink. The justification is strong competent from urban areas may reach it easily if roads are accessible for handcrafts, but for local drinks/food may not be interested to supply their commodity to the rural centers using the opportunity of all weather roads. The positive and significant effect of female adult ratio in food/drink implies the traditional female domination of the activities in Oromia region or largely in Ethiopia.

Woldehanna and Oskam (2001) have also made deep study in northern Ethiopia, Tigray on the paper titled “Economic Analysis and Policy Implication of Farm and Off-farm Employment”. The literature tries to answer some questions among these I present here what I believe it could be in line with my study. Farmers engage in different off-farm activities to diversify their income

and enable them to feed themselves during crop failure, but the main worry is whether it is possible to support farmers to enable them participate without scarifying the farm productivity. To address this problem they analyze the link between farm and off-farm activities and their determinants. Eventually they found a substantial increase of farm income as a result of income diversification in general and promoting off-farm employment in particular. This may because off-farm income helps to finance farming activities such as purchase of farm labor and other inputs such as seeds, fertilizer and pesticides. Still there are contradictory hypothesis regarding off-farm employment that on the one hand it produce more cash and on the other hand less labor to be employed on the farm. But the evidence implies the positive impact of off -farm employment on farm productivity outweighs than its compromising effect. This is because one if labor was unemployed/under employed on farm off-farm employment may have no effect on farming, second farmers can make crop choice go friendly with off -farm work and thirdly if the marginal productivity of labor off-farm is better than on their farm still they can hire labor on their farm and supply their labor off-farm. Reardon 1977 confirmed that, if there are entry barriers and rationing in the labor market, diversifying income in to off-farm activities will be more difficult for poor than for rich households (cited in Reardon, 2001). Hence, it is important to examine the determinants of participation and take mitigation measures. The result shows off-farm wage employment decreases and off-farm self employment increases with an increase of farm output. Other variables that affect off-farm employment are number of dependents, family size, wage, area of land cultivated, livestock wealth and the value of off-farm equipment owned. It increases with family size, wage and livestock wealth and decrease with number of dependents, land cultivated and non-labor income.

Hagos and Holden (2003) have examined the welfare impacts of credit access and program participation measured by changes in household's per capita expenditure, the change in household's level of off-farm income over time and others. They found significantly positive impact of credit on the level of off-farm income among households located in tabias that are close to major markets.

2.5. Conceptual Frame Work

The literatures provide us ample evidences in favor of the explanations for farm households' motivations to diversify their incomes. Based on these empirical review we present the conceptual frame work that tries to link the major factors that are expected to determine household's decision to participate in off-farm activities and level of off-farm employment income below. These factors can be shown by categorizing as factors that influence relative returns to agricultural production and related risks, referred as incentives, and factors that affect the household's capacity of participation in different off-farm activities (Reardon et al., 2001). Incentives allow farm households to participate in farm and off-farm wage employment, off-farm self employment and social and community service activities to generate incomes. While the factors that limit the capacity of households to participate in off-farm work includes such as education, access to credit and age. Involvement of rural farm households in either farm activities or both farm and off-farm activities will increase the households' income. The conceptual framework, which established as a foundation for the factors that determine off-farm employment participation and income is presented in the figure below.

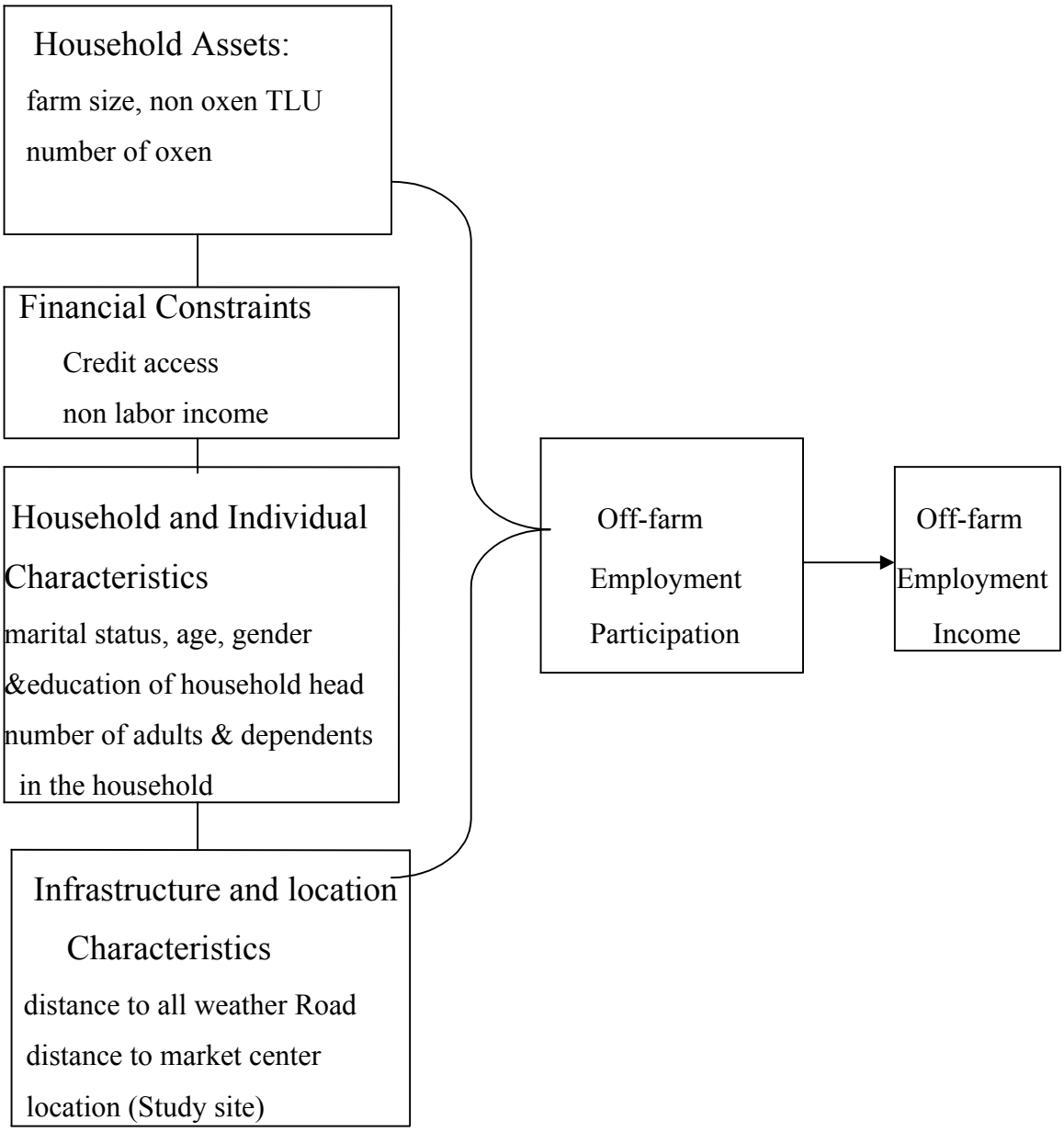


Figure1.The conceptual framework for the determinants of off-farm employment participation and incomes from them

CHAPTER THREE

DATA SOURCE, METHODOLOGY AND MODEL SPECIFICATION

This section presents an overview of the study area description, the methods used for data collection and econometric models applied in the study. That is, it includes the data source and data collection methods, sample size and sampling techniques, methods of data analysis, econometric models apply for the study and description and expected sign of explanatory variables.

3.1. Area Description and Data Source

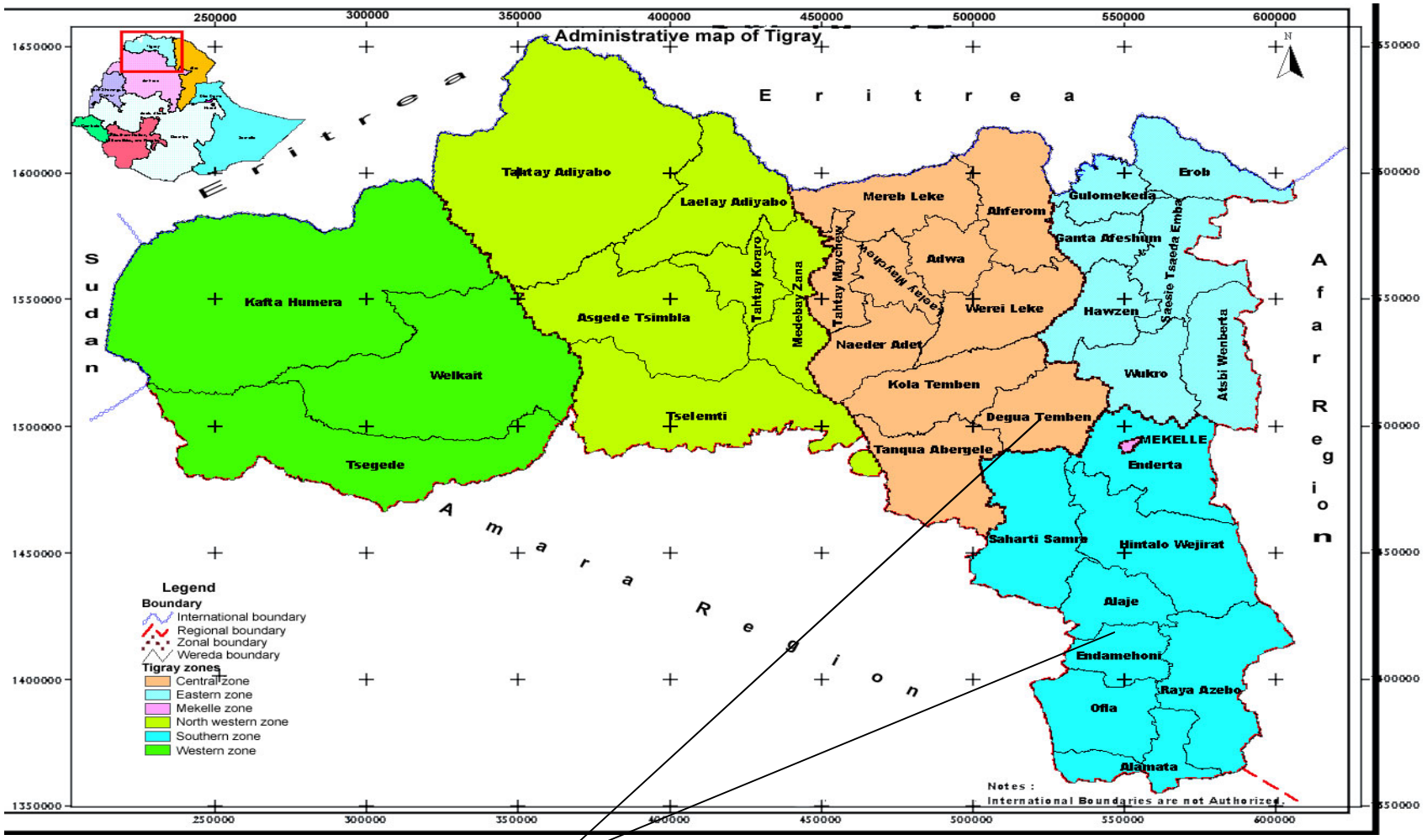
3.1.1. Description of the Study Area

The study is conducted in Tigray region, Northern Ethiopia. The region belongs to the Sudano-Sahelian agro-climatic region of Ethiopia. Its climate is characterized by one long dry season from October to May followed by a short rain season from March to April in some parts of the region and the long rainy season mostly from late June to early September. The region is characterized by erratic rainfall and frequent droughts, and on average it receives between 550 and 650 mm rain fall annually (Nigisti, 2007). Tigray region has seven administrative zones, each of which is further divided into a number of Woredas, Tabias and Kushets. The seven zones are Eastern, Central,Southern, South Eastern, North Western, Western and Mekelle. The survey has been conducted in two rural Woredas of Tigray: Endamokonni and Degua Tembien Woredas located in the Southern and South Eastern Zones of Tigray respectively.

Degua Tembien is located at $39^0$10’ E longitude and $13^0$38’ N latitude. It borderes with Kelteawlaelo Woreda in the North, SahartiSamre Woreda in the South, Enderta Woreda in the East and Kolla Tembien Woreda in the West. The capital of the Woreda is Hagereselam which is located 50 km far from the regional capital, Mekelle city. According to 2007 census, the Woreda has 124,590 (115,815 in rural and 8775 in urban) population in 2010. The total population in 2010 can be disaggregated by gender as follows, rural: male 58,404, female 57,411; urban: male

4025, female 4750. The Woreda have a total of 27,319 rural households. The Woreda's climatic zones are lowland/Kola/, temperate /Woinadega/ and highland /Dega/ with proportion of 26%, 30.5% and 43.5% of the Woreda's area respectively. The altitude of the Woreda capital is 2618 meters above sea level and its daily temperature ranges from 18^0c to 25^0c. The annual rain fall of the Woreda ranges from 600- 800 mm (Admasu, Kiros &Memhur, 2011).

The second site, Endamokonni Woreda, is found at a distance of 660 km from Addis Ababa and 120 km from Mekelle town.The Woreda is bordered on the South by Ofla Woreda, on the West by Amhara region, on the North by Alaje and on the East by Raya Azebo Woreda. The capital of the Woreda is Maichew. Geographically, the town is located at $12^0$47'N latitude and $39^0$32'E longitude with average elevation of 2400 meters above sea level (REST, 1996). According to the information obtained from the agriculture and rural development office of the Woreda, Endamokonni has mean annual rain fall of 785 mm and mean annual minimum and maximum temperature of 9^oc and 22^oc, respectively.



Source: Bureau of Finance & Economic Development

Fig2..Administrative map of Tigray region

Study site Woredas

Based on the 2007 national census conducted by the Ethiopian Central Statistical Agency (CSA), Endamokonni Woreda has a projected total population of 91,256; 46,001 male and 45,255 female inhabitants in 2010. The total households in the Woreda are 20,465.

The rural people in these Woredas are mainly dependent on rain fed subsistence agriculture. Crops like barely, wheat, pea, Teff, lentil and faba beans are mainly cultivated in the area. The main livestock types are cattle, sheep and goats. Livestock provides drought and draft power, food and income.

Off-farm employment activities for e.g; petty trade and sale of labor are also important livelihood strategies in the study Woredas. Wage labor employment opportunities are available locally on the farms of the better-off households, and in the nearby towns. The productive safety-net program (PSNP) is also playing very important role in reducing food insecurity.

3.2. Methodology and Model Specification

3.2.1. Data Source and Data Collection Methods

In this survey both primary and secondary data were collected from different sources. A structured interview schedule was developed to collect the necessary primary data in which both quantitative and qualitative data are gathered from the sample respondents through face to face interview. The questionnaire includes information on households demographic characteristics, livelihood activities that the households involve in, off-farm employment activities for households that at least one member of the household participates in such activities during the survey period, number of labor hours/days these individuals supplied to off-farm wage work and wage rate per day and annual earnings from off-farm self-employment activities. In addition, gross income from sale of crop, livestock and livestock products and value of crop and livestock or livestock by products used for household consumption and variable costs like expenditure on fertilizer, seed, pesticide, herbicide, purchased livestock feed, and expenditure for livestock medicine were collected. Qualitative data are also gathered from focus group discussion and informal discussions with farmers and personal observations.

In addition, secondary data has been collected from available reports and records of the agriculture and rural development offices of the study Woredas, Ethiopian CSA, Mekelle branch and published journals from websites and unpublished literatures from different sources.

3.2.2. Sample and Sampling Method

Multistage stratified sampling method was applied to select the respondents. The choice of the two Woredas is purposively. The reason why these Woredas have chosen is: first, there is a substantial variation in the nature and availability of off-farm activities. Second, there are variations between the two Woredas in their access to information, market and infrastructure facilities. The choice of tabias is made in such a way that: first the 23 rural tabias in Degua Tembien and 18 tabias in Endamokonni are clustered in to two, based on their distance to Hagereselam and Maichew towns respectively. Then one tabia from the nearest and another one form the far-off clusters have been chosen from both Woredas randomly. For Endamokonni and Degua Tembien, the first cluster includes tabias within the radius of 10 kilometers, while the second cluster include tabias lie at radius larger than 10 Killometers from Maichew and Hagereselam towns respectively. Tabia Shimta and Meswaeti are chosen from the nearest and far-off clusters respectively in Endamokonni Woreda. Similarly, tabia Limat and Seret are chosen from the nearest and far-off clusters respectively in Degua Tembien Woreda. Next, all Kushets from the tabias chosen above have taken to choose our sample respondents. The reason that distance is used for clustering tabias is: first, it enables to capture substantial variations in the nature and access to off-farm activities between these tabias. So, those tabias can represent for the respective Woredas. Second, there are variations among tabias in access to information, market and infrastructure facilities. The respondent households are chosen from the list of household heads in each tabia using systematic random sampling method. Total sample of 205 rural households, 96 households from Endamokonni and 109 from Degua Tembien are chosen using probability proportional to size.

3.2.3. Methods of Data Analysis

The determinants of participation in off-farm employment are analyzed separately for off-farm wage employment and off-farm self-employment activities. Off-farm wage employment consists of agricultural and non-agricultural casual wage employment and regular salary or wage work.

Self-employment, on the other hand, consists of selling firewood and charcoal, stone mining, grain and livestock trading, petty trading, handcraft selling, selling local brewery, selling food and tea etc. This separation is preferred because we expect the factors that affect participation in these activities may be different. Similarly, to examine the determinants of off-farm employment income, incomes from off-farm work are disaggregated in to off-farm wage income and off-farm self-employment income.

3.3. Econometric Models

The logit and probit models are the most frequently used models when the dependent variable is dichotomous (Gujarati, 2004; Verbeek, 2004; Green, 2003; Woodridge, 2002). The probit and logit models are quite similar, so they usually generate predicted probabilities that are almost identical.The study is interested on analyzing off-farm employment participation, by disaggregating in to off-farm wage employment and off-farm self employment activities. The reason why we separate is that we assume the determinant factors are not the same across the two sets of off-farm employment activities. We apply bivariate probit model to identify the determinant variables and their marginal effect on households' participation for the two sets of off-farm employment activities. This because we assume households participation decision in those activities may not be independent. Babatunde and Matin (2010) modeled a similar problem in Nigeria. They apply a multivariate estimation procedure because households in rural Nigeria often participate in several off-farm activities and the choices among those activities are not mutually exclusive. This would also be appropriate in our context for households in rural Tigray often participate in several off-farm activities that are not mutually exclusive. Thus, separate probit or logit models may not be appropriate and may generate biased and inconsistent coefficients, as the error terms are likely to be correlated across the two off-farm employment equations. Bivariate probit model is sound to estimate two participation equations with correlated disturbances.

Once participation is modeled, the next task is to estimate the factors that affect the level of income from off-farm employment. Sample selection bias is a potential problem in predicting the income earned from off-farm work due to the truncated nature of the dependent variable. An estimate of off-farm income regression, that does not take selection bias in to consideration

suffers from an omitted variable problem, what we call it the effect of selection on incomes. Hence, Heckman two-step selection model is employed. This approach is chosen because it considers for selection bias that could arises due to missed data. The most common version of the Heckman procedure is to estimate in two stages. In the first stage, a probit is estimated on the decision to work off-farm with data from both participants and non-participants, using the estimation result inverse mills ratio is then calculated. In the second stage estimation of the OLS model on level of off-farm income using data from the participant households only while including inverse mills ratio to account selection bias is then undertaken. Alternatively, a single stage estimation procedure using a likelihood function can be carried out. Therefore, the determinants of income from off-farm wage work and off-farm self employment are estimated using Heckman's two stage procedure.

3.3.1. General Specification of the Econometric Models Used for Analysis

In order to fulfill objectives two and three the following functional form is used.

$$Y_i = f(Z_1, Z_2, Z_3, Z_4) \quad (1)$$

The econometric model for the functional form stated in equation (1) can be specified as:

$$Y_i = C_{0i} + C_{1i} Z_1 + C_{2i} Z_2 + C_{3i} Z_3 + C_{4i} Z_{4i} + \varepsilon_I \quad (2)$$

Where,

Y_i= dichotomous variable representing participation of households in off-farm work type i = 1, 2 for the probit model; and it is equal to one if the household participates in off-farm work and zero otherwise. For the income model, Y_i represents the amount of wage income and self-employment income.Z_1, Z_2, Z_3 and Z_{4i} denotes for the vector of independent variables used during analysis. C_{0i}, C_{1i}, C_{2i}, C_{3i}, and C_{4i} represent for the row vectors of coefficients to be estimated, and ε_i error term with standard properties.

3.3.2. Specification of the Bivariate Probit Model

The general specification for the bivariate probit model as stated in Green (2003) presents in equations 3(a& b) and 4 below. Participation of rural households on several off-farm employment activities depends on the value of unobserved (latent) variable which indicates some utility difference for the rural households by participating and not participating in off-farm works. Often the relationship between the value of the unobserved (latent) variable Y_i^* and the observed characteristics X'_j and unobserved characteristics ε_i are assumed to be linear. Y_i^* for the off-farm wage employment, Y_1^* and off-farm self employment, Y_2^* can separately be stated as:

$$Y_1^* = X'_1\beta_1+\varepsilon_{1,} \quad Y_1 = 1, \text{ if } Y_1^* > 0, \text{ 0 otherwise} \tag{3a}$$

$$Y_2^* = X'_2\beta_2+\varepsilon_{2,} \quad Y_2 = 1, \text{ if } Y_2^* > 0, \text{ 0 otherwise} \tag{3b}$$

and

$$E[\varepsilon_1 | X'_{1,} X'_2] = E[\varepsilon_2 | X'_{1,} X'_2] = 0$$

$$Var[\varepsilon_1 | X'_{1,} X'_2] = Var[\varepsilon_2 | X'_{1,} X'_2] = 1$$

$$Cov[\varepsilon_1, \varepsilon_2 | X'_{1,} X'_2] = \rho$$

Where, i = 1, 2 and j=1, 2…n

ρ= the cross equation correlation coefficient

Individual's decision to participate or not to participate in off-farm employment depends on the value of Y_i^*.The observed value, Y_i= 1(households participated in some off- farm employment) if ($Y_i^*>0$ and Y_i = 0 (not participated) if $Y_i^* \leq 0$. Where, $\mathbf{X'_1}$ and $\mathbf{X'_2}$ are the vectors of explanatory variables in equation 3a and 3b above respectively. If the vector $\mathbf{X'} = \mathbf{X'_1} \cup \mathbf{X'_2}$ and let $\mathbf{X'_1}\boldsymbol{\beta}_1 = \mathbf{X'}\boldsymbol{\gamma_1}$ and $\mathbf{X'_2}\boldsymbol{\beta_2} = \mathbf{X'}\boldsymbol{\gamma}_2$. Thus, $\boldsymbol{\gamma_1}$ contains all the nonzero elements of $\boldsymbol{\beta_1}$ and possibly some zeros in the positions of variables in $\mathbf{X}$ that appear only in the other equation. $\boldsymbol{\gamma_2}$ also defined similarly. The bivariate probit for the probability of participation in off-farm employment is thus defined as:

$$Prob[Y_1=1, Y_2=1 | X'] = \Phi_2[\mathbf{X'}\boldsymbol{\gamma}_{1,} \mathbf{X'}\boldsymbol{\gamma_2}, \rho] \tag{4}$$

Where Y_1 and Y_2 denote participation in off-farm wage and self-employment activities respectively, **X′** indicates for the vector of independent variables.

3.3.3. Specification of Heckman two-step Model

Trying to estimate off-farm income using OLS method may lead to biased result. Heckman selection model that adopted from Green (2003) and Verbeek (2004) is appropriate to estimate off-farm employment income because it corrects for sample selection bias. The off-farm employment income equation is present in equation (5).

$$\log I_i^* = X_1'_i \beta_1 + \varepsilon_{1i} \qquad (5)$$

I_i^* implies individual household's off-farm employment income. It is observable for the participants. Yet it is unobservable for the non-participant households. $X_1'_i$ is a vector of observable factors that affect the level of off-farm employment income and ε_{1i} error term.

Let the selection model for household's participation in some off-farm work be explained by the equation stated below. Here, the equation indicates that households participation depends on some value h_i* of a latent variable.

$$h_i^* = Z_1'_i \alpha_1 + \mu_{1i} \qquad (6)$$

Thus, we can determine the participation and actual off-farm employment income from the selection equation as stated below.

$$h_i = \begin{cases} 1 \text{ if } h^*_i > 0 \\ 0 \text{ if } h^*_i \leq 0 \end{cases} \qquad (7)$$

With the decision to participate in off-farm work given by h_i=1 if individuals participated and h_i=0 otherwise, where h_i is a variable indicates participation in off-farm employment, Z is a vector of variables that affect households decision to participate in some off-farm activities and μ_{1i} the corresponding error term. And the outcome equation (for our case actual off-farm employment income equation) is explained as:

$$\text{LogIi} = \begin{cases} X_1'_i\beta_1 + \varepsilon_{1i} & \text{if } h^*_i > 0 \\ \text{Unobserved if } h^*_i \leq 0 \end{cases} \quad (8)$$

Assuming: $\mu_{1i} \sim N(0, \delta^2)$

$\varepsilon_{1i} \sim N(0,1)$

$\text{corr}(\mu_{1i}, \varepsilon_{1i}) = \rho$

The conditional expected income of individual households who participate in off-farm employment becomes,

$$\begin{aligned} E\{I_i \mid h_i=1\} &= X_1'_i\beta_1 + E\{\varepsilon_{1i} \mid h_i=1\} \\ &= X_1'_i\beta_1 + \rho\phi(Z'_{1i}\alpha_1) \,/\, \Phi(Z'_{1i}\alpha_1) \\ &= X_1'_i\beta_1 + \rho\lambda \end{aligned} \quad (9)$$

If the correlation coefficient $\rho=0$, estimating the model using OLS gives unbiased result. The term $\rho\phi(Z'_{1i}\alpha_1) \,/\, \Phi(Z'_{1i}\alpha_1)$ is known as inverse Mill's ratio; usually represents by lambda, λ and reflects for the selection variable that captures for selection bias.

3.4. Description and Expected Sign of Variables Used in the Analysis

In this section description of explanatory variables used in the analysis and their expected sign for the participation decision and level of off-farm employment income are discussed.

i. Individual and household characteristics

Age of the household head: age is used to indicate the general experience of the household head. At younger ages the probability of working off-farm will increase. At older ages the overall labor hours will decline and the demand for leisure will increase, hence the off-farm labor work hours and corresponding income decrease.

Sex of the household head: male headed households are expected to diversify their livelihood more than female headed households because of cultural differentiation of activities for men and women. In addition, mostly females spend their time at home engaged in preparing food, looking after children and fetching water etc. Hence they may not participate in off-farm activities outside their village like long distance trade and wage employment.

Education status of the household head: Education attainment is measured as four dummy variables categorizing educational level of head into illiterate, informally literate primary education (grade 1 to 6) and grade above 6 .The dummy variable is specified in such a way that the latter three dummy variables will take value one for a household head who has attained the specified education level. Three dummy variables are used taking illiterate group as reference for education level. Education is expected to have a positive effect on both off-farm employment participation and incomes from them.

Number of children 5 years old or under: as younger children require high level of care, the number or presence of preschool children is expected to have a negative impact on the probability of off-farm participation. But, the presence of young children has no impact on the income earned from off-farm work once they get the opportunity of participation.

Number of children 6-10 years old: The number of older children able to decrease domestic or on-farm tasks. Hence, the household's reservation wage decreases and subsequently increases the likelihood of off-farm work participation.

Number of adult male and female household members: The presence of more adults in the family could lower the opportunity cost of household labor working off-farm. Hence, the number of adult male (15-64 years old) and adult female (15-64 years old) household members are expected to increase the probability of off-farm work participation.

ii. Households' asset variables

Per capita livestock holding: the per capita livestock holding expressed in tropical livestock units is a proxy for household's asset holding. The direction of causality of livestock holding is

however, ambiguous as there could be differences in livestock types in this respect. The presence draft animals can motivate off-farm self employment and on the contrary the availability of cattle can be used as a source of income hence substituted for off-farm wage income and compete for the scarce family labor as they may demand much labor for their management.

Cultivated farm size per capita: per capita farm size is another proxy for household's asset position. Intuitively**,** we expect farmers with larger farms to participate in the off-farm markets less frequently and earn less when they do participate as they expect to spend much of their labor time on their farm.

iii. Financial constraint indicators

Credit received by farm households: The indicator of the household cash constraint is measured by the dummy whether the households have at least one member who demanded loan from formal and/or informal financial sources. Theory states the relaxation of cash constraints reduces participation in rural wage employment at household level. On the contrary credit solves the financial constraint to start own business (self-employment), hence, increases the probability of households participation in off-farm work. Therefore, its effect cannot be anticipated a priori.

Non labor income: This variable has positive effect on the marginal value of non-work time and hence a negative effect on the participation and the off-farm employment income. If leisure is a normal good, higher non labor income could lead to increase in quantity of leisure demand at the expense of off-farm work.

iv. Infrastructure and location characteristics

Distance to the nearest all weather road**:** is measured by the average time needed to get the nearest all weather road. This can help us to capture costs related to marketing, transaction and information. Theoretically, it is expected that large distance (measured in hours) from individual home to all weather road reduces the probability of off-farm work participation and income earned from them too.

Distance to major (Woreda) market: is the time taken to get the nearest major market (town) from individuals home. The participation of rural household members in off-farm employment activities is affected not only by their willingness and ability to take part in such activities but also by the demand for the labor (in case of wage employment) and demand for commodity supplied (in case of self employment activities). To capture the impacts of access to and availability of employment opportunities, researchers have used different location related measures. Distance to market is expected to affect negatively for the probability of participation and level of off-farm employment income.

District: is a dummy for study site which will be used to handle for Woreda level characteristics, its sign cannot be anticipated a priori.

CHAPTER FOUR

4. RESULT AND DISCUSSION

4.1. Descriptive Statistics

In this section descriptive statistics for the livelihood activities of the sample households in the study area; the importance of off-farm employment income to the relatively poor and rich households; and the participation rate of rural households in different off-farm activities across the study Woredas based up on sex of the household head are presented.

Farm households in the study area are found to diversify their livelihood activities and income. Even though farm households mainly depend on agriculture which consists of crop and livestock production or both, off-farm activities have been found to support the life of many poor farm households in Tigray.

To describe the livelihood activities in the study area, we are presented the main sources of income and participation rate of the sample households in each source. Moreover, the composition of total household income by source has presented to show the importance of the different sources of income.

Table 1 shows the participation rate and composition of household's total income. About 97.6 % of the sample households derive their income from farming which accounts 61.1% (49.5% crop income and 11.6% livestock income) of the total annual household income. The remaining 39% of household income is obtained from different off-farm sources which includes off-farm wage employment, off-farm self-employment and non-labor income. The result indicates that 73.7% of the sample households in the study area have at least one member in the household being involved in off-farm employment activities during the survey period. In this study off-farm employment activities are categorized in to off-farm wage employment and off-farm self employment activities. About 56% of the households have reported some income from off-farm wage, which accounts for 22.5% of total household income. Wage employment in turn can be classified in to: paid public development work, manual off-farm work and non manual (skilled)

off-farm work (Woldehanna & Oskam, 2001; Ellis, 2000). But for this study since non manual (skilled) off-farm work is scarce, simply we categorized off-farm wage employment in to off-farm wage work excluded paid public development work and paid public development work (food for work/ cash for work program). Among the sample households 40.4% participate in food for work/cash for work program; which constitutes 2.4% of the total household income. Only 27.3 percent of the total sample households are involved in wage work excluded paid public development work. This accounts for 20.3% of the annual household income. Paid development work involves community soil and water conservation programs including aforestation, construction of community services like school, health center, road, farmers training center and other community work done under the food for work program. About 37.6 % of the sample households are involved in self-employed non agricultural activities; which accounts only one-tenth of the total household income. It includes activities like grain and livestock trade, sell of handcraft, coffee/tea selling, stone and sand collection, fire wood and charcoal selling, shop-keeping, selling local drinks like 'Tella' and 'Tegi' and other local services, as well as petty trade. Most of the off-farm work participants respond that the income obtained from off-farm source is used for consumption and some farmers use it for buying oxen, fertilizer and farm instruments. But very few use it for investment in non-farm activities and none of the households uses off-farm employment income for saving. This gives us some insight that expanding off-farm sector could promote the farm sector. Because this enables farmers to get sufficient amount of income which in turn is used for farm investments.

Table1. Household participation in different livelihood activities and composition of total household income

Income by source	Participation rate(%)	Mean share of total income (%)
Total farm income	97.6	61.1
Crop income	96.6	49.5
Livestock income	74.2	11.6
Total off-farm income	82.4	38.7
Off-farm work income	73.7	32.8
Total wage income	56.1	22.5
Total wage income excluded paid public development work	27.3	20.3
Paid public development work	40.4	2.4
Self-employed income	37.6	10.3
Non labor income	17.1	5.9

Source: Computed from own survey data, (2012)

Note: All income sources are net costs. Crop income is computed by subtracting explicit variable costs (like costs for seed, fertilizer, herbicides or pesticides, hire labor, rent in oxen or motor etc) from the amount of own harvest consumed plus sold times by the prevailing market price in the area. Similarly, livestock income is calculated as the value of live animals and raw animal products/services sold and consumed net of some inputs such as purchased feed, hired labour and veterinary services. The method is used in reports on livestock income (FAO, 2011).

4.1.1. Characterizing Off-farm Employment Participation Rate by Sex of the Household Head and District

Table 2 indicates the participation rate of households in different off-farm employment activities by sex of the household head and district. In the survey data 28.8% of the household heads are females. On average 20.5% of the participant households are female headed. But, there is a difference in participation of female households in the various off-farm employment activities across the study sites. Female headed households take larger percent for off-farm self-employment and paid public development work participation than their male counterparts in Endamokonni Woreda. This may be due to the availability of large market for self-employment activities that are appropriate for females. The reason why female headed households hold larger rate of participation than male headed households for food /cash for work program is because

female headed households are poorer than male headed households in the area and the program usually targets to the poorest households that able to work. This is based on our survey data which indicates the average annual agricultural income for male and female headed households are Birr 9363.35 and 4183.95 respectively. But, the reverse is true in Degua Tembien Woreda: female headed households take fewer participation rates in all off-farm activities. This may be due to the existence of small market for off-farm products /services appropriate for females, and the sample households from Degua Tembien constitutes small number of female headed households by chance. In both districts female headed households participate least in off-farm wage employment excluded paid development work. This is due the existence of less time available for females. Besides, traditionally the society considers that nonfarm wage work as belongs only for males. Another reason could be since employers mostly demand male labor for off-farm wage work.

Table 2.Off-farm work participation rate by sex of the household head and district

	Endamokonni (N=96)		DeguaTembien (N=109)	
Type of off-farm activities	Male	Female	Male	Female
Off-farm self employment	17.7	25	28.4	4.6
Total wage employment	37.5	27.1	40.4	8.3
Wage-employment excluded paid development work	19.8	10.4	23.9	0.9
Paid development work	25	26	22.9	7.3
Total off-farm work participation	46.9	32.3	58.7	10.1

Source: Source: Computed from own survey data, (2012)

4.1.2. Importance of Off-farm Employment Income across Different Economic Groups

In this part, the relative importance of various income sources across the different income strata of rural households is presented. A useful method of analyzing income composition across different economic groups is sorting by deciles, quintiles or quartiles. But, only 204 observations have full information to analyze income composition. Therefore, quartile group is appropriate in this case. In order to better reflect household's living standards the quartiles are constructed based on per capita household income. The first and the fourth quartiles could be used as proxy for the relatively poorest and richest groups respectively.

Table 3 shows income composition by per capita income quartiles. We find that the importance (share) of farm income increases with per capita household income while the importance of off-farm income decreases. The richest households (households with the highest per capita income) derive most of their income from farming which accounts 80.6% of their annual total income. The first quartile or lower 25% households, in contrast, derive their largest (66.5%) income from off-farm sources, which in turn constitutes 44.3% wage income, 10.3% self-employment income and 11.9% non-labor income. Though aggregate farm income contributes less for the poorest group, crop income is very important next to off-farm income for them, which accounts for over 58% of their overall income. Thus, households who are better in agricultural income obtain less from off-farm activities. This implies off-farm activities serve as a survival strategy for the rural poor in Tigray. Therefore, this is in line with the empirical argument that rural households in Africa engage themselves in off-farm /non-farm activities more out of necessity than choice (DFID, 2004).

The large contribution of wage income to the poorest group of households implies that off-farm wage does not require initial capital. Hence, the poor can enter easily**.** Finally, non-labor income consists of income received from relatives or friends, gifts, pension, remittance, renting out assets, inheritances and government food aid. In this study, we find that non labour income decreases with an increase in per capita household income. This is because non labor income, in our case, largely derives from government food aid; and government food aid is a program which mainly targets to the poorest of poor.

Table 3. Average composition (%) of annual net household income by per capita income quartiles

	Per capita income quartiles			
Income source	1st	2nd	3rd	4th
Total farm income[1]	33.1	55.3	75.6	80.6
Crop income	58.6	32.9	52.4	54
Livestock income	-25.5	22.3	23.2	26.6
Total off-farm income[2]	66.5	44.3	24.3	19.3
Off-farm employment income[3]	54.6	39.8	20.4	16.3
Off-farm wage income	44.3	21.7	14.3	9.7
Off-farm Self employed income	10.3	18.1	6.1	6.6
Non-labor income	11.9	4.5	3.9	3

Source: Computed from own survey data, (2012)

[1]Total farm income= Crop income +Livestock income

[2]Total off-farm income= Off-farm employment income+ non-labor income

[3]Off-farm employment income=Off-farm wage income +off-farm self employment income

4.1.3. Descriptive Statistics for the Dependent and Independent Variables

Table 4 presents definition and descriptive summary of the variables used for the regression analyses. The result shows that most of the sample households are male headed, only 25.85% are female headed. Over 52 % of the household heads in the sample are illiterate, 8.3% are informally literate while the rest 28.3% and 11.2% are formally literate with grades 1-6 and above grade 6 respectively. The mean age of the household heads in the sample is 45 years. The mean number of children with 5 years old or under in the household for the sample is 0.87. On average, there are 0.78 children with 6-10 years old per household for the sample.

On average, an individual owns 0.21 livestock units. The average per capita farm size is 0.456 tsimdi which is smaller than 1 tsmdi (0.25 hectare), the average landholding in Tigray. The mean annual per capita non-labor income of the sample households is Birr 72.39 with a 6% share of total net household income (see Table 1). Almost 65% of the sample households have been acquired loan either from formal or/and informal sources during the survey period. On average, it takes 0.408 and 1.79 hours to reach the nearest all weather road and nearest major market from individual's home respectively.

Table 4. Descriptive statistics of variables

Variable	Description	Mean/ percent	Std.dev
Offwpart	Dummy for participation in off-farm wage work Yes=1 Otherwise=0	 56.10% 43.90%	
Offspart	Dummy for participation in off-farm self employment Yes=1 Otherwise=0	 37.56% 62.44%	
pcoffwinc	Annual per capita household wage income (Birr)	218.739	383.384
pcoffsinc	Annual per capita household Self-employed income (Birr)	149.907	365.054
sex_hh	Sex of the household head Male=1 Female=0	 74.15% 25.85%	
age_hh	Age of the household head (years)	45.12	12.475
educ_hh	Education status of the household head Illiterate Informally literate Grade1-6 for head Grade above 6 for head	 52.2% 8.29% 28.29% 11.22%	
child1	Number of children with 5 years old or under	0.873	0.836
child2	Number of children 6-10 years old	0.785	0.775
adumale	Number of adult male household members	1.444	0.972
adufem	Number of adult female household members	1.419	0.874
pctlu[1]	Per capita livestock holding (excluded oxen) in TLU	0.17	1.208
Pcfarmsize[2]	Per capita area cultivated by household in the survey year (tsimdi)	0.458	0.561
pcnlaborinc	Annual per capita non-labor income (Birr)	72.394	257.523
credit	Dummy whether the household demands loan during the survey year (yes=1) (No=0)	 35.12% 64.88%	
dalwroad	Distance to nearest all weather road in hours	0.408	0.459
dmajormkt	Distance to nearest major market in hours	1.797	0.869
district	Dummy for study Woreda Endamokonni=1 DeguaTembien=0	46.83% 53.17%	

Source: Computed from own survey data, (2012)

[1]Tropical Livestock Unit conversion factors are for cattle=0.7, sheep or goats=0.1, horses=0.8, mules=0.7, donkeys=0.5, calves=0.15chickns=0.01;

[2]Tsimdi is equivalent to 0.25 hectare.

4.1.4. Description of Variables that Significantly Differ among Off-farm Labor Employment Participant and Non Participant Groups

We apply t-test and chi-square test in order to have a clear picture on the variables that represent: individual and household characteristics, household asset position, financial constraints, and location and infrastructure characteristics which significantly vary between the off-farm employment participant and non participant groups.

Variables that significantly vary among participant and non participant samples at 1%, 5% or 10% level of significant are presented in separate Tables.

Table 5 shows mean difference of continuous variables for off-farm wage work participant and non participant groups. On average household heads for off-farm wage work non participant samples are found older than for participants. The corresponding figure for the participant and non participant farmers is about 43.48 and 47.21 years respectively. The mean age difference between these groups has found to be significant at 5% level. This indicates that older household heads are less likely to participate in off-farm wage work as it demands high physical and mental energy.

The average number of children with five years old or under for the participant and non participants groups has found to be 0.77 and 1 respectively. This difference is significant at 10% level. But the number of children with 6 to 10 years old shows big difference between the off-farm wage participant and non participant samples. On average, participant households have 0.66 children with 6 to 10 years old and the non participant group has 0.94. The mean difference between the off-farm wage participant and non participant groups is significant at 1% significance level. This is in line with prior expectation as the presence of more children demands much time for treatment.

Table 5.Mean differences of continuous variables for off-farm wage work participants and non participants

Variables	Participants		Non participants		Total			
	Mean	Std.dev	Mean	Std.dev	Mean	Std.dev	P-value	t-value
age_hh	43.48	11.47	47.21	13.42	45.12	12.47	0.033**	2.139
child1	0.77	0.79	1	0.87	0.87	0.83	0.054*	1.933
child2	0.66	0.74	0.94	0.78	0.78	0.77	0.009***	2.637

Source: computed from own survey data, (2012)

***, ** and* represent significant at the 1%, 5%, and 10% level, respectively

Sex of the household head is one of the discrete variables that significantly affect off-farm wage participation. From the total sample households, 30.4% of the participants and 20 % of the non participants in off-farm wage work are female headed households. The number of off-farm wage participant female headed households is lower than the off-farm wage participant male household heads. Gender difference between the participant and non participant groups is significant at 10% level.

Among the groups 46.1% of the participants and 62.2% of the non participants in off-farm wage work are from Degua Tembien district and the corresponding 53.9% and 37.8% are from Endamokonni. The chi-square test implies participation rate is significantly different across the two study sites at 5% level. This indicates that geographic location of farm households also affects participation.

Table 6. Discrete variables that significantly vary between off-farm wage employment participant and non participant groups

Variables	Value	Participants	Non participants	P-value	χ^2-value
sex_hh	0	35(30.4)	18(20)	0.090	2.867*
	1	80 (69.6)	72(80)		
district	0	53(46.1)	56(62.2)	0.022	5.279**
	1	62(53.9)	34(37.8)		

Source: computed from own survey data, (2012)

** and* represent significant at the 5%, and 10% level, respectively

Numbers in parentheses indicate percentages

Table 7 and 8 shows the mean difference of significant variables (continuous and discrete) across the participant and non participant groups for off-farm self employment. Significant mean difference was observed between off-farm self employment participants and non participants with respect to age. The result of the survey revealed that heads for off-farm self employment participant and non participant groups have an average age of 42.55 and 45.12 years respectively. Household head age difference between the groups is significant at 5% level. This indicates that farmers with older heads hesitate to diversify their livelihood to off-farm self employment activities.

Moreover, non-participant groups get higher average per capita non-labor income which is birr 99.28 as compared with the participant samples who have birr 27.69. Results of the independent sample t-test difference in mean non labor per capita income between the participant and non-participant households was found to be statistically significant at 10% level (t=1.94). This confirms that farmers with good access for non labor income opportunities are less likely to engage in off-farm self employment activities.

There is also difference in access to infrastructure proxied by the distance to the nearest all weather road. The off-farm self employment participant and non participant groups takes on average 0.33 and 0.44 hours to reach the nearest all weather road from their home respectively. This difference is significant at 10% level

Table7.Mean differences of continuous variables for off-farm self employment participants and non participants

Variables	Participants		Non participants		Total			
	Mean	Std.dev	Mean	Std.dev	Mean	Std.dev	P-value	t-value
age_hh	42.55	10.56	46.66	13.29	45.12	12.47	0.022**	2.306
pcnlaborinc	27.69	110.81	99.28	311.83	72.39	257.52	0.053*	1.940
dalwroad	0.33	0.33	0.44	0.51	0.40	0.45	0.098*	1.659

Source: Computed from own survey data, (2012)

** And* represent significant at the 5%, and 10% level, respectively

Sex of the head significantly affects off-farm self employment participation. From the total sample households, 37.7% of the participants and 18.7% of the non participants are female headed households. The number of participant female headed households is lower than the corresponding male headed households. Gender difference between the participant and non participant groups is significant ($\chi^2 = 8.97$) at 1% significance level.

There exists also difference in credit use (loan demand) between the participant and non participant groups for off-farm self employment activities. 44.2% of the participant group and 29.7% of the non participant group uses loan during the survey period (see Table 8). The difference is significant at 5% level. The participant group are likely to use credit because credit helps to start own business like local brewery, selling tea/coffee and livestock and grain trade.

Table 8. Discrete variables that significantly vary between off-farm self employment participant and non participant groups

Variables	Value	Participants	Non participants	P-value	χ^2-value
sex_hh	0	29(37.7)	24(18.7)	0.003***	8.970
	1	48(62.3)	104(81.2)		
credit	0	43(55.8)	90(70.3)	0.036**	4.416
	1	34(44.2)	38(29.7)		

Source: Computed from own survey data, (2012)

***and** represent significant at the 1% and 5%, level, respectively
Numbers in parentheses indicate percentages.

4.2. Econometric Result Analysis

4.2.1. Estimation Procedure

The data have been tested for multicollinearity, hetroskedasticity and normality problems using different STATA out puts. Multicolinearity test helps to identify highly correlated independent variables. In this case household size has shown serious multicolinearity problem; and we exclude from our model. The most commonly applied diagnostic test for multicolinearity problem is Variance Inflation Factor (VIF). As a rule of thumb, if the VIF of a variable exceeds 10, that variable is said to be highly collinear (Gujarati, 2004). In order to apply probit and

Heckman's selection model normality and homoskedasticity of the error term should hold (Green, 2003). Hence, these assumptions required to be tested .We tested for heteroskedasticity (for the log-lin model) and normality of the error terms for the different regression outcomes. We use Breurusch-pagan hetroskedasticity test to check existence of hetroskedasticity problem for errors. To check for normality of data skewness and kurtosis as well as the Shapiro-Wilk and Shapiro-Francia tests are used (Park, 2008). The homeskedasticity (for the log-lin model), and normality assumption for both the participation and log-linear off-farm income models are not rejected (see Annex 1). For probit it is difficult to test hetroskedasticity problem. Thus, we assumed the presence of hetroskedasticity and apply robust during analysis to correct the problem for the participation equations. The level of per capita off-farm work income equations has transformed in to log-linear functional form for in an attempt to eliminate the heteroskedasticity problem.

4.2.2. Probit Estimates for Off-farm Labor Employment Participation

A bivariate probit model has been run to estimate the determinants of participation in off-farm wage employment and off-farm self-employment activities. The bivariate probit model is the simplified version for the multivariate probit estimator that has been used previously in studies explaining household's participation in different off-farm activities by (Babatunde & Qaim, 2010; Berg & Kumbi, 2006). The estimation result in the first stage refers to off-farm wage employment participation while the second stage shows to the estimation results of off farm self-employment participation. The bivariate probit model has tested for its appropriateness over the univariate probit model. The likelihood function of the bivariate probit model indicates significant (χ^2= 92.33, with P=0.0000), showing strong explanatory power of the model (see Annex3). However, the cross-equation coefficient (ρ) that indicates the correlation of error terms across the two off-farm activities is not significantly different from zero (χ^2 = 1.696, with P=0.193). Hence, applying the univariate probit model for the off-farm self-employment and off-farm wage equations separately could generate unbiased and consistent estimates (Green, 2003). Given these results two univariate probit models are estimated for the off-farm wage work and off-farm self employment participation equations. The results of the two univariate probit models and their marginal effects are presented in Table 9 and 10.

Individual and household characteristics: number of children with 5 years old or under, number of adult female and male in the family and sex and age of the head relates with off-farm wage participation as we anticipated earlier. The relation between off-farm wage participation and education status of the head (formal education) and number of children with 6-10 years old contradicts to our prior expectation. Except, sex and informal education of the head the sign for individual and household characteristics has found as expected for off-farm self employment participation.

Household asset variables: The direction for per capita farm size is as prior expectation in case of off-farm self employment participation. However, it contradicts to what we expect for off-farm wage work. Per capita livestock unit positively and significantly relates with off-farm self employment participation, while it relates negatively with off-farm wage work participation.

Financial constraint variables: The direction of effect for non-labor income on off-farm wage and off-farm self employment participation is as expected. Credit relates with off-farm work participation positively.

Infrastructure and location characteristics: The average distance to the nearest all weather road and distance to the nearest major market are negatively related with the likelihood of participation as expected.

In general, age of the household head, formal education for head, number of children (both with 5years old or under and 6-10 years old), and dummy for district are found to be significant at 5% and 1% significant level for off-farm wage work participation. Sex of the household head, number of adult male in the household, per capita non labor income, credit, per capita livestock holding, distance to the nearest all weather road and major market and district are found to be significant at 10%, 5% or 1% level for off-farm self employment participation. Detail explanations for these variables are provided under.

Male headed households are less likely to participate in off-farm self-employment than the female headed counterparts, and the corresponding marginal effect indicates that male headed households are 31.09 percentage points less likely than female headed households to participate in off-farm self employment activities, holding other covariates at their mean. This is because

female headed families have relatively lower agricultural income compare to male headed counter parts hence they diversify to off-farm self employment activities to feed their family.

The probability of participation in off-farm wage employment significantly decreases with age of the household head at 1% significance level. The marginal effect for age implies that as age of the household head increases from its mean value 45.12 to 46.12 years, the chance of being involved in off-farm wage employment will decrease by 1.7 percentage points, while other variables are kept at their mean. This is consistent with theory and intuition that as household heads get old they become experienced on farming and need to spend more time on their farm instead of looking for off-farm activities. Another reason is as household heads get old they may not fit for physically hard off-farm activities. The nature of the data also shows that the minimum age of household heads registered is 23 years and the largest 80 years; hence, it is realistic to conclude that as age increases the likelihood of participation decreases. But its effect for participation in off-farm self-employment is not significant even at 10% level.

Households with primary education (grade1-6) and education level above grade 6 for head, have significantly lower probability of participation in off-farm wage work over the illiterate individuals. Education level above grade 6 is found to be significant at1% level, while primary education is significant at 5% or above level. The result for the marginal effect shows that the probability of participation in off-farm wage work lowers by 21.75 and 36.91 percentage points for those who attain grade1-6 and above grade 6 than the illiterate counterparts, keeping other regressors at their mean. This may be because educated household heads are more productive on their farm; hence they spend their time on farm activities. Educated heads also send their sons and daughters to school, thus these they can't participate in wage work. So, reservation wage for off-farm family labor increases. On the other hand, education appears to be irrelevant for participation decision in off-farm self employment. This may be because the off-farm self employment activities performed by rural people in Tigray may not need education. Other researchers have also found similar result in Ethiopia (Woldehana, 2000; Abebe, 2002).

The number of adult female insignificantly relates with off-farm work participation. The presence of more adult male family members, on the other hand, significantly increases the likelihood of participation in off-farm self employment, but its effect not significant for off-farm wage

employment. On average, as the number of adult males in the family increase from 1.5 to 2.5, the likelihood of participation in off-farm self employment increases by 9.07 percentage points. This is inline with prior expectation, families with surplus male labor are more likely to take part in off-farm self employment activities because as the number of adults increase the produce from agriculture alone cannot feed large families, this induces them to diversify their livelihood to off-farm self employment activities. However, for wage employment it is not significant; as most of the adults are students during the survey period and most of the time off-farm wage work is full time task. Hence, it is not convenient for them to involve in off-farm wage; instead they involve in self employment activities which can be done side by side with their study.

The number of preschool children (with 5 years old or under) and older children (with 6 to 10 years old) in the household negatively and significantly affects likelihood of participation in off-farm wage employment at 1% level. But its effect is not significant for self-employment. The reason is as young children require more care they may reduce excess time available for off-farm activities. The effect of preschool children on participation in off-farm employment contradicts with similar study made in south west China which states more children requires more cash, hence, households need off-farm work to fill their finical need (Cuddy, Hongmei & Gutema, 2008). But, Chinese are economically rich hence they can employ child care givers; hence having young children may not be a constraint for participation. Brick, Garvey, and Cuddy (2005) found results inline with our finding. The marginal effect estimates indicates that keeping other variables at their mean, having one more child with age of 5 or under in the household the chance of participation in off-farm wage work reduces by14.07 percentage points. Similarly for children 6 to 10 years old the chance could reduce by 16.72 percentage points

Financial constraint of family members has also an impact on the decision of households. The result of the analysis shows that, non labor income negatively and significantly affects participation of households in off-farm self employment. A one birr increase in per capita non labor income from its mean value (72.39 birr) to 73.39 birr reduces the likelihood of participation in off-farm self-employment by 0.05 percentage points. This indicates households look for off-farm self employment activities to solve their liquidity constraint. In contrast, credit positively and significantly relates with off-farm self employment participation. Households who use credit during the survey year are 14.93 percentage points more likely to take part in non-farm self-

employment activities than those who did not use. This shows credit plays an important role to begin own business like shop, local drinks, tea or food selling and activities that need skill like tailor, waving and others. Nevertheless, their effect for the probability of participation in off-farm wage is not significant..

Apart from the financial condition of the households, off-farm employment participation determined by asset and infrastructure variables. Number of livestock in the household is not significant for off-farm wage participation. However, its effect is positive and significant for off-farm self-employment at 10% level. The marginal effect shows as the number of livestock unit per capita increases from 0.17 to 1.17 the chance to participate in off-farm self employment increases by 48 percentage points, while other variables are kept at their mean value.

Farm size does not show a significant effect in any of the equations at 10% significant level. But if we choose 11% significant level it significantly decreases the probability of participation in off-farm self-employment. This finding confirms that there exists no significant variation in land holding among the sample households as land is expressed in per capita terms. Asset position partly favors with result from (Woldehana &Oskam, 2001). The infrastructure variables, distance to the nearest all weather road and distance to the nearest major market significantly reduces the probability of participation in off-farm self employment. Keeping all covariates at their mean, when the time taken to reach the nearest all weather road and nearest major market increases from 0.41 to 1.41 hours and from 1.79 to 2.79 hours respectively, the chance to involve in off-farm self employment lowers by19.36 and 12.99 percentage points respectively. This result is consistent with theory, the likelihood of working off-farm by the household members' decreases as the market is located far away from their village. Results in favor of our result has found from Nigeria (Babtunde & Qaim, 2010). The effect of these variables however, is not significant for wage employment participation.

Location dummy has also included as explanatory variable to capture other factors that create differences in participation decision of households in the two sample sites. Individuals in Endamokonni Woreda has high probability of participation in off-farm wage and off-farm self employment activities over those who live in Degua Tembien Woreda. The estimates for marginal effects shows that keeping all variables at their mean, individuals in Endamokonni have

19.48 and 19.10 percentage points more chance of participation in off-farm wage employment and off-farm self employment than those in, Degua Tembien respectively. This is reasonable as Endamokonni is near Maichew town which has relatively wider market. But for Degua Tembien Woreda the nearby market is Hagereselam town, which has relatively smaller market for off-farm employment opportunities.

Table 9.Univariate Probit and Marginal effect estimates for off-farm wage employment participation

Explanatory variables	Coefficient	Z	P>|Z|	Marginal effect (+)
sex_hh(male=1)	0.446	1.58	0.114	0.1762
age_hh	-0.044	-4.42	0.000	0.0173***
Informally literate (yes=1)	0.384	0.96	0.339	0.1434
Grade 1-6 for head (yes=1)	-0.553	-2.15	0.032	-02175**
Grade >6 for head (yes=1)	-0.978	-2.75	0.006	-0.3691***
Adumale	0.177	1.61	0.106	0.0694
Adufem	0.034	0.30	0.766	0.0131
child1	-0.359	-2.62	0.009	-0.1407***
child2	-0.426	-3.01	0.003	-0.1672***
Pcnlaborinc	-0.001	-1.08	0.278	-0.0002
credit (yes=1)	0.096	0.47	0.642	0.0373
pcfarmsize	0.044	0.21	0.833	0.0172
Pctlu	-0.068	-0.97	0.331	-0.0267
Dalwroad	-0.089	-0.42	0.674	-0.0352
Dmajormkt	-0.043	-0.37	-0.709	-0.0169
district (Endamokonni=1)	0.504	2.44	0.015	0.1948**
_cons	2.814	4.45	0.000**	
Number of observations	205			
Log pseudo likelihood	-120.699			
Wald chi2 (16)	41.15			
Prob > chi2	0.0005			

***, **, and * significant at the 1%, 5%, and 10% level, respectively.

(+) for dummy variables the marginal effect is the discrete change of dummy variables from 0 to 1, P>|z| correspond to the test of the underlying coefficient being 0.For definitions of variables, (see Table 4).

Table 10.Univariate Probit and Marginal effect estimates for off-farm self employment participation

Explanatory Variables	Coefficient	Z	P>|Z|	Marginal effect (+)
sex_hh(male=1)	-0.805	-2.92	0.003	-0.3109 ***
age_hh	-0.016	-1.44	0.150	-0.0062
Informally literate (yes=1)	-0.404	-1.00	0.318	-0.1431
Grade 1-6 for head (yes=1)	0.046	0.18	0.857	0.0171
Grade >6 for head (yes=1)	0.304	0.84	0.399	0.1185
Adumale	0.238	2.14	0.032	0.0907**
Adufem	0.002	0.02	0.984	0.0008
child1	-0.059	-0.42	0.674	-0.0225
child2	0.065	0.49	0.621	0.0250
Pcnlaborinc	-0.001	-2.27	0.023	-0.0005**
credit (yes=1)	0.388	1.95	0.052	0.1493*
pcfarmsize	-0.325	-1.61	0.107	-0.1238
Pctlu	1.268	2.22	0.026	0.4808**
Dalwroad	-0.509	-2.12	0.034	-0.1936**
Dmajormkt	-0.342	-2.67	0.007	-0.1299***
district (Endamokonni=1)	0.505	1.99	0.046	0.1910**
_cons	0.143	1.78	0.075*	
Number of observations		205		
Log pseudo likelihood		-113.253		
Wald chi2 (16)		39.40		
Prob > chi2		0.0001		

***,** and * significant at the 1%, 5%, and 10% level, respectively.

(+) for dummy variables the marginal effect is the discrete change of dummy variables from 0 to 1, P>|z| correspond to the test of the underlying coefficient being 0. For definition of variables, (see Table 4).

4.2.3. Heckman two step Model Estimates for Off-farm Employment Income

In this section we analyze the determinants of income from off-farm wage work and off-self employment sources. This can help in particular to understand why some households are better able to derive income from specific off-farm activities than others. It answers also the question do factors that affect off-farm employment participation can also affect the corresponding level of income from them. Since many households do not derive income from off-farm wage and off-farm self-employment activities, off-farm employment income is not observed for the non

participants. Hence if we apply OLS using data from the participant samples only we may get biased and inconsistent results. For this reason we apply Heckman two step selection models to estimate the income equations, because Heckman model helps as to consider observations that have missed data. Heckman model has also been used by other authors in similar contexts (Hagos & Holden, 2003; Brick, Garvey & cuddy, 2005).

The covariates that we use to analyze the participation in off-farm activities are also used to identify the factors that affect income from them. To avoid identification problem that could arise during estimation, the variable number of children with 6-10 years old has excluded from off-farm wage income equation and used only in the corresponding selection equation. Similarly, per capita non labor income has excluded from the outcome equation for off-farm self employment. The results for the outcome equations of the Heckman two step selection models are presented in Table 11. Here, results for the outcome equations are estimation results for determinants of per capita off-farm employment income (per capita off-farm wage and per capita off-farm self-employment income) after correcting for selection bias. The estimate for mills lambda for the off-farm wage participation, λ=1.456, given at the bottom of table 11 is statistically significant at 5% significant level (with, p= 0.05). Similarly the estimate for mills lambda for off-farm self employment participation, λ= -1.372 is significant at 10% level with (P=0.076). This indicates the existence of selection bias. Hence, applying ordinary least square (OLS) method without correcting for selection bias can give us biased and inconsistent coefficients.

As the first stage represents participation, which has discussed above, here we focus on the second stage, which describes the determinants of off-farm employment income given that households participate in certain activities.

Most of the explanatory variables relate with logarithm of per capita off-farm wage income as expected. But, education level for head (specifically grade1-6), number of adult male and female in the household and per capita farm size contradicts to what we expect prior. Sex and education status for household head (informal and formal above grade 6) and distance to the nearest all weather road relates with level of off-farm self employment income as expected. But, the sign of coefficients for household age, number of adult male and female in the household, per capita farm size and distance the nearest market are found different from prior expectation.

Household and individual characteristics affect both the participation in off-farm employment and the corresponding earnings, although their sign is different for some of these variables. Variables that indicate household asset position significantly affect the level of off-farm wage income per capita; but their effect is not significant for off-farm self employment income. Access to infrastructure, represented by distance to the nearest all-weather road and distance to the nearest major market were not significant for off-farm wage employment participation. However, distance to the nearest major market significantly relates with off-farm wage income at 10% level. The dummy for study site (district) significantly affects both the likelihood of wage work participation and incomes from it. Most of the variables that affect off-farm self-employment participation become insignificant for the level of income from these activities. For example, credit, per capita non labor income, per capita total livestock units (pctlu), distance to the nearest all weather road, distance to the nearest major market and dummy for study site significantly affects participation in off-farm self employment while their effect is not significant for the level of off-farm self employment income.

Sex of the head, number of adult male in the house household and number of children with 6 to 10 year old significantly relates with off-farm self employment participation and level of per capita income from it. The detail explanations for the determinants of income from off-farm (wage and self employment) are presented below.

Male headed households found to earn higher income from off-farm self employment than female headed households. But the effect of sex of head on the level of per capita off-farm wage income is not significant, given participation. Higher earning for male headed families favors with prior expectation. This is because most of the time females in the study area involve in traditional enterprises that earn low return and can perform at farm yards. Besides, females may not get enough time to involve in profitable activities like long distance trade that demands more time and resource. Therefore, females, if they provide with skill enhancing training, time saving technologies and low interest rate credit, it is possible to improve their income from off-farm self employment.

Age and informal education for head have also identified as essential determinants of off-farm wage income.

Being older for the head of the household lowers the level of off-farm wage income per capita. But, age doesn't have a significant effect on the level of income from off-farm self employment. This is because as individuals get old they may be paid less or work less frequently in off-farm wage work as they physically become weak. Unlike wage work off-farm self employment does not need much physical and mental energy.

Informal education for household head positively and significantly affects per capita off-farm wage income. But, the coefficients for formal education (grade 1-6 and above 6 for head) are insignificant at 10% level. This is because in this study most of the off-farm wage income is derived from manual wage work and food/cash for work program which does not need formal education at all. But, for informal education it is due to the existence of some social services that demand informal education, for e.g., priests paid for their service in churches. The effect of education (formal and informal) on off-farm self-employment income is not significant.

Number of adult male household members with 15 to 64 years old significantly decreases earnings from both off-farm wage and off-farm self employment. This is because most of the adults in the survey area are students, thus their contribution to the off-farm earnings is less as off-farm earning is expressed in per capita terms.

The number of tropical livestock units per capita has a negative and significant effect for off-farm wage earnings. This is because as livestock management needs intensive labor it may compete for the scarce family labor that can allocate to off-farm wage work, hence lowers off-farm wage income. In addition, livestock holding is an indication of household wealth. Some of the wage income in our sample comes from cash / food for work program participation. But, the wealthy farmers can't be targeted for the program. Thus, livestock holding relates negatively both with the participation in off-farm wage work and income from it. As we try to explain above the number of livestock can enhance participation in off-farm self employment, but its effect is not significant for the level of per capita income from it. Though it doesn't affect participation for off-farm wage employment, farm size increases off-farm wage income, given participation. This

implies individuals with large farm size; unless they earn high income from off-farm wage they cannot be involved in it. This indicates the reservation wage for families with large farm holding is high.

Location and infrastructural characteristics as proxied by district dummy, distance to the nearest all weather road and distance to the nearest major market have also significant effect on off-farm wage income. Distance to the major market lowers income from wage employment, but its effect for off-farm self employment income is not significant. This means that residence in far off areas hinders off-farm wage work participation, and in case they participate inadequate access to market limits wage income.

Finally, individuals in Endamokonni obtain significantly higher income from off-farm wage employment than those in Degua Tembien. This may be due the size of the nearest major market they can access easily. As Maichew town with total population of 37581 has larger market relative to Hagereselam town with a total population of 8022 CSA (2007), both the availability of wage employment and wage rate is higher in Maichew town than do in Hagereselam. Therefore, it is logical for households to get higher wage income in Endamokonni Woreda than their counter parts in Degua Tembien.

Table 11. Heckman two step estimates for off-farm employment income

Explanatory Variables	Log off-farm wage Income per capita		Log off-farm self employed income per capita	
	Coef.	Std. Err.	Coef.	Std. Err.
sex_hh(male=1)	0.345	0.333	0.992	0.594*
age_hh	-0.042	0.019**	0.001	0.016
Informally literate (yes=1)	1.237	0.560**	0.221	0.702
Grade 1-6 for head (yes=1)	-0.096	0.381	0.429	0.369
Grade >6 for head (yes=1)	0.322	0.554	0.068	0.533
Adumale	-0.449	0.161***	-0.483	0.208**
Adufem	-0.114	0.143	-0.243	0.164
child1	-0.422	0.217*	0.243	0.211
Child2	-------	--------	-0.495	0.201**
Pcnlaborinc	-0.000	0.000	-------	------
Credit(yes=1)	-0.090	0.260	-0.056	0.353
Pctlu	-0.182	0.109*	-0.010	0.137
Pcfarmsize	0.477	0.237**	0.269	0.351
Dalwroad	-0.060	0.292	-0.175	0.487
Dmajormkt	-0.278	0.164*	0.422	0.279
district(Endamokoni=1)	0.754	0.342**	-0.212	0.343
Mills lambda	1.455	0.742**	-1.372	0.772*
_cons	7.060	0.832***	6.282	1.019
Number of observations	205		205	
censored observations	90		128	
uncensored observations	115		77	
Wald chi2 (30)	59.59		60.39	
Prob > chi2	0.0001		0.0004	

***, **, * significant at the 1%, 5%, and 10% level, respectively

CHAPTER FIVE

5. CONCLUSION AND RECOMMENDATION

5.1. Conclusion

In this study the determinants of household's participation in different off-farm employment activities and incomes earned from are analyzed. Since we expect the factors that affect participation in different off-farm activities and corresponding income may not be the same, we disaggregate off-farm activities in to off-farm wage work and off-farm self employment. Moreover, we characterize the main livelihood activities in the area and examine the importance of off-farm employment to the relatively poor and rich households using simple descriptive statistics.

The result shows that 73.7% of the sample households in the two districts participate at least in one of the off-farm activities and derive some income from these activities. On average, the sample households derive just over sixty percent of their income from farming and almost forty percent from off-farm sources. Off-farm employment accounts one third of the total net annual household income and the smallest portion comes from non-labor income sources: like remittance, pension, renting out assets, government aid etc. The descriptive analysis also shows gender wise difference in participation rate across the study sites. Female headed households take larger percent of participation than their counter parts in Endamokonni but the reverse is true for Degua Tembien. The poorest groups of households are found to drive two thirds of their income from off-farm sources; in which the largest amount obtains from wage income, while off-farm self employment and non labor income sources constitute the smallest part. On the contrary, the relatively richest group drives about eighty percent of their income from farming and only nineteen percent is derived from off-farm sources. Hence, the share of off-farm income is negatively related with total per capita household income. This implies, off-farm employment is very important to the poorest. But the better off households benefit much from farming.

The regression result for the determinants of off-farm employment participation indicates that the factors that hinder or motivate participation are not the same for off-farm wage and self-employment activities.

Families belong to older household heads and more children with ten years old or below are constrained to take part in off-farm wage work. Families with household heads who attend some primary education or above are less likely to participate in off-farm wage compare to those who are illiterate. But the household asset and financial constraint proxies are found to be insignificant.

However, for off-farm self employment we find that individual and household characteristics, household asset, financial constraints, and location and access to infrastructure variables significantly affect participation. Male headed households have lower probability of participation in off-farm self employment compared to female headed households. Households who have poor access to market and infrastructure are less likely to participate in off-farm self employment activities. Per capita non labor income negatively and significantly correlated with off-farm self employment participation. We also find per capita land size negatively relates with off-farm self employment but it is not significant. This may imply a push nature of off-farm self employment activities for poor asset base, insufficient crop income and market imperfections make individuals resort to off-farm activities to supplement their meager agricultural income and to smooth inter season cash flow and consumption. On the other hand, households with more adult male members, large livestock holding and credit users have high probability of participation for self employment. Household's probability of participation for both off-farm wage work and off-farm self employment is higher in Endamokonni Woreda compared to the reference Woreda, Degua Tembien.

As we expected, the determinants of off-farm employment income given participation is not the same to the determinants of participation.

Age of the household head, number of adult male and number of children with 5 years old or below in the household, per capita livestock holding and distance to major market are significantly associated with lower per capita off-farm wage income. Families with informally

educated household heads earn higher per capita off-farm wage income over households with illiterate heads. Per capita land holding is positively associated with the level of per capita off-farm wage income among the participant households. District dummy have significantly positive effect as in the participation equation.

The number of adult male members and per capita livestock holding positively and significantly associated with off-farm self employment for the participant households. Interestingly, once they take part in some off-farm self employment activities, male headed households earn more than their female counterparts. Number of adult male and children with 6 to 10 years old in the family negatively and significantly relates with earnings from off-farm self employment at 5% level. Poor access to infrastructure as proxied by distance to the nearest all weather road negatively relates with off-farm earnings, but its effect is not significant even at 10% significant level.

Further research is required that tries to study the demand side of the labor market together with the supply side thus it could enable to understand the rural labor market in the region.

5.2. Recommendations

Off-farm work plays very important role on the livelihood of the poorest of poor, because it is very important source of income for them next to crop income. Thus, respective bodies should work more on enhancing the livelihood of this segment of rural households by introducing interventions that improve crop production and support the off-farm sector in order to create job opportunities that poor households can participate and benefit directly.

Poor access for market and infrastructure lowers off-farm employment participation (though not significant for off-farm wage employment) and corresponding earnings (though not significant for off-farm self employment).Thus, local markets (towns) should be promoted by introducing infrastructure facilities like road, electricity, water and others in order to create new self employment opportunities and make profitable for the already existed ones. Connecting rural centers with all weather roads can also help to reduce transaction costs related with searching wage employment.

Even though they have more probability to participate in off-farm self employment activities, female headed households earn lower than their counterparts from these activities. This is because most of them are involved in low return small scale traditional non-farm activities like: weaving, spinning, pottery and preparing local drinks like ‘Tella’ and ‘Tegi’, selling tea or coffee and shop keeping, Thus, they should be provide with skill enhancing training in order to improve the quality of commodities they provide and get attractive return from these activities. Besides, they should also be provide with low interest rate credit which can help them to enlarge the scale of their enterprises, hence could reduce costs related with those activities and make them profitable.

Older household heads are less likely to participate in off-farm wage and earn less in case they participate. Thus, the governmental and non governmental agencies should find sustainable aid to old ages because they cannot supplement their agricultural produce with other sources.

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Annexes

Annex1

Specification tests for the off-farm participation and income equation

(i) Variance Inflation Factor for Continuous Explanatory Variables

Variable	VIF	1/VIF
hhsize	10.67	0.119848
adumale	3.07	0.325212
adufem	2.74	0.365271
child2	2.66	0.376403
child1	2.32	0.431884
pcfarmsize	1.42	0.706002
age_hh	1.34	0.747212
pctlu	1.27	0.786922
dalwroad	1.12	0.893764
dmajormkt	1.09	0.915292
pcnlaborinc	1.04	0.958494
Mean VIF	2.40	

(ii) Normality Tests

Off-farm wage participation

Shapiro-Wilk W test for normal data

Variable	Obs	W	V	z	Prob>z
e	205	0.98733	1.931	1.516	0.06481

Shapiro-Francia W' test for normal data

Variable	Obs	W'	V'	z	Prob>z
e	205	0.98660	2.202	1.662	0.04821

Off-farm self employment participation

Shapiro-Wilk W test for normal data

Variable	Obs	W	V	z	Prob>z
e	205	0.99390	0.929	-0.169	0.56716

Shapiro-Francia W' test for normal data

Variable	Obs	W'	V'	z	Prob>z
e	205	0.99459	0.890	-0.251	0.59917

Skewness/Kurtosis tests for Normality

			------- joint ------	
Variable	Pr(Skewness)	Pr(Kurtosis)	adj chi2(2)	Prob>chi2
e	0.769	0.328	1.05	0.5904

Specification tests for the off-farm income equation (log-Lin)

. e.g; log per capita wage income)

Shapiro-Wilk W test for normal data

Variable	Obs	W	V	z	Prob>z
e	205	0.98991	1.537	0.991	0.16087

Shapiro-Francia W' test for normal data

Variable	Obs	W'	V'	z	Prob>z
e	205	0.99020	1.610	1.010	0.15623

Skewness/Kurtosis tests for Normality

			------- joint ------	
Variable	Pr(Skewness)	Pr(Kurtosis)	adj chi2(2)	Prob>chi2
e	0.039	0.606	4.59	0.1009

(iii) Hetroskedasticity test

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

Ho: Constant variance

Variables: fitted values of lnpcwinc

chi2(1) = 0.52

Prob > chi2 = 0.4696

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

Ho: Constant variance

Variables: fitted values of lnpcsinc

chi2(1) = 3.39

Prob > chi2 = 0.0656

Annex2

Share of income sources by income quartile

(Here only for the 1st and 4th quartile group are present)

sum sharagrinc sharcpinc sharlsinc sharoffinc sharoffwinc sharoffsinc sharnonlabinc in 1/51

Variable	Obs	Mean	Std. Dev.	Min	Max
sharagrinc	51	.3306425	3.915631	-21.22222	15.70589
sharcpinc	51	.5856602	2.557386	-5.037736	15.70589
sharlsinc	51	-.2550178	2.486916	-17.33333	1.647887
sharoffinc	51	.5458865	3.911855	-14.70589	22.22222
sharoffwinc	51	.4432959	3.890759	-14.70589	22.22222
sharoffsinc	51	.1025906	.460477	-.8450704	1.99377
sharnonlab~c	51	.1193738	.3996418	0	2.033209

sum sharagrinc sharcpinc sharlsinc sharoffinc sharoffwinc sharoffsinc sharnonlabinc in 154/204

Variable	Obs	Mean	Std. Dev.	Min	Max
sharagrinc	51	.806143	.2090076	.0959317	1
sharcpinc	51	.5401575	.2881934	-.0560301	1
sharlsinc	51	.2659854	.2740517	0	.9225926
sharoffinc	51	.1632642	.1938188	0	.7881022
sharoffwinc	51	.0970575	.1349466	0	.6027122
sharoffsinc	51	.0662067	.124767	0	.5978358
sharnonlab~c	51	.0305928	.0772278	0	.3013561

Annex3

Estimation results of the probability and Heckman two step model

(a) Bivariate probit regression

Number of obs = 205

Wald chi2(32) = 92.33

Log pseudolikelihood = -233.09534

Prob > chi2 = 0.0000

	Robust				
	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]
offwpart					
sex_hh	.4616831	.2828034	1.63	0.103	-.0926015 1.015968
age_hh	-.0442512	.009956	-4.44	0.000	-.0637645 -.0247378
informalit	.3978418	.4036243	0.99	0.324	-.3932474 1.188931
grade1_6	-.551179	.2576242	-2.14	0.032	-1.056113 -.0462449
grade>6	-.9736537	.3546553	-2.75	0.006	-1.668765 -.2785421
adumale	-.1801773	.1097947	-1.64	0.101	-.3953711 .0350164
adufem	.0380606	.1164298	0.33	0.744	-.1901377 .2662589
child1	-.3596153	.1359897	-2.64	0.008	-.6261502 -.0930803
child2	-.4286927	.1422244	-3.01	0.003	-.7074473 -.1499381
pcnlaborinc	-.0004534	.0004105	-1.10	0.269	-.0012579 .0003512
credit	.0948708	.2063332	0.46	0.646	-.3095349 .4992765
pctlu	-.0775413	.0704108	-1.10	0.271	-.2155439 .0604613
pcfarmsize	.0313832	.2084575	0.15	0.880	-.377186 .4399524
dalwroad	-.0874446	.2144961	-0.41	0.684	-.5078492 .3329599
dmajormkt	-.0434807	.115783	-0.38	0.707	-.2704111 .1834497
district	.5001442	.2070053	2.42	0.016	.0944213 .905867
_cons	2.808618	.6294816	4.46	0.000	1.574857 4.042379

offspart						
sex_hh	-.7981432	.2745097	-2.91	0.004	-1.336172	-.2601141
age_hh	-.0153913	.0111038	-1.39	0.166	-.0371543	.0063717
informal	-.4207677	.4087089	-1.03	0.303	-1.221822	.380287
grade1_6	.0582869	.2593808	0.22	0.822	-.4500901	.5666638
grade>6	.31953	.3583972	0.89	0.373	-.3829155	1.021976
adumale	.2372424	.1121105	2.12	0.034	.0175098	.4569749
adufem	-.0088377	.1174944	-0.08	0.940	-.2391224	.221447
child1	-.0569907	.140309	-0.41	0.685	-.3319913	.2180098
child2	.0520509	.1323294	0.39	0.694	-.20731	.3114118
pcnlaborinc	-.0013801	.00065	-2.12	0.034	-.0026542	-.000106
credit	.3809307	.2009774	1.90	0.058	-.0129777	.7748391
pctlu	1.102811	.5840946	1.89	0.059	-.0419935	2.247615
pcfarmsize	-.3349992	.2042567	-1.64	0.101	-.7353349	.0653365
dalwroad	-.5085976	.2436987	-2.09	0.037	-.9862383	-.030957
dmajormkt	-.3414924	.1274416	-2.68	0.007	-.5912733	-.0917114
district	.4765083	.2548385	1.87	0.062	-.0229659	.9759825
_cons	1.149488	.6409105	1.79	0.073	-.1066737	2.405649
/athrho	-.1690568	.1298214	-1.30	0.193	-.4235021	.0853886
rho	-.1674644	.1261807			-.3998766	.0851816

Wald test of rho=0: chi2(1) = 1.69579 Prob > chi2 = 0.1928

(b) Probit regression, reporting marginal effects (off-farm wage participation)

Number of obs = 205
Wald chi2(16) = 41.15
Prob > chi2 = 0.0005
Log pseudolikelihood = -120.69951 Pseudo R2 = 0.1413

offwpart	dF/dx	Robust Std. Err.	z	P>|z|	x-bar	[95% C.I.]	
sex_hh*	.1762065	.1104594	1.58	0.114	.741463	-.04029	.392703
age_hh	-.017338	.0038976	-4.42	0.000	45.122	-.024977	-.009699
informalit*	.1434468	.1402281	0.96	0.339	.082927	-.131395	.418289
grade1_6*	-.2175241	.0994239	-2.15	0.032	.282927	-.412391	-.022657
grade>6*	-.3691233	.1159578	-2.75	0.006	.112195	-.596396	-.14185
adumale	-.0693832	.0430031	1.61	0.106	1.4439	-.153668	.014901
adufem	.0136086	.0456931	0.30	0.766	1.41951	-.075948	.103166
child1	-.1407035	.053728	-2.62	0.009	.873171	-.246009	-.035399
child2	-.1672153	.0554031	-3.01	0.003	.785366	-.275803	-.058627
credit*	.0373301	.0799464	0.47	0.642	.35122	-.119362	.194022
pcnlab~c	-.0001756	.0001621	-1.08	0.278	72.3949	-.000493	.000142
pcfarm~e	.0172749	.0821597	0.21	0.833	.457648	-.143755	.178305
pctlu	-.0267044	.027446	-0.97	0.331	.170395	-.080498	.027089
dalwroad	-.0352322	.0837815	-0.42	0.674	.408135	-.199441	.128977
dmajor~t	-.0169155	.0454044	-0.37	0.709	1.79683	-.105907	.072076
district*	.1948433	.078001	2.44	0.015	.468293	.041964	.347722

obs. P | .5609756
pred. P | .5755359 (at x-bar)

(*) dF/dx is for discrete change of dummy variable from 0 to 1
z and P>|z| correspond to the test of the underlying coefficient being 0

(c) Probit regression, reporting marginal effects (off-farm self employment)

Number of obs = 205
Wald chi2(16) = 39.40
Prob > chi2 = 0.0010
Log pseudolikelihood = -113.25323 Pseudo R2 = 0.1653

offspart	dF/dx	Robust Std. Err.	z	P>|z|	x-bar	[95% C.I.]	
sex_hh*	-.3109572	.1030266	-2.92	0.003	.741463	-.512886	-.109029
age_hh	-.0061666	.0042825	-1.44	0.150	45.122	-.01456	.002227
informal*	-.1431402	.1300616	-1.00	0.318	.082927	-.398056	.111776
grade1_6*	.0178152	.099029	0.18	0.857	.282927	-.176278	.211909
grade>6*	.1185387	.1425471	0.84	0.399	.112195	-.160848	.397926
adumale	.0907002	.0420706	2.14	0.032	1.4439	.008243	.173157
adufem	.0008941	.0444195	0.02	0.984	1.41951	-.087955	.086167
child1	-.022475	.053438	-0.42	0.674	.873171	-.127212	.082261
child2	.0250091	.0507007	0.49	0.621	.785366	-.074363	.124381
credit*	.1492919	.0769319	1.95	0.052	.35122	-.001492	.300076
pcnlab~c	-.0005168	.0002263	-2.27	0.023	72.3949	-.00096	-.000073
pcfarm~e	-.1238449	.0768534	-1.61	0.107	.457648	-.274475	.026785
pctlu	.4817895	.2222932	2.22	0.026	.170395	.046103	.917476
dalwroad	-.193605	.0910627	-2.12	0.034	.408135	-.372085	-.015125
dmajor~t	-.1299641	.0484123	-2.67	0.007	1.79683	-.22485	-.035078
district*	.1910049	.0949847	1.99	0.046	.468293	.004838	.377172

obs. P | .3756098
pred. P | .3773622 (at x-bar)

(*) dF/dx is for discrete change of dummy variable from 0 to 1 z and P>|z| correspond to the test of the underlying coefficient being 0

(d)Heckman selection model -- two-step estimates (regression model with sample selection)

Number of obs	= 205
Censored obs	= 90
Uncensored obs	= 115
Wald chi2(30)	= 59.59
Prob > chi2	= 0.0010

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lnpcwinc						
sex_hh	.3448275	.3333834	1.03	0.301	-.308592	.998247
age_hh	-.0420938	.0192231	-2.19	0.029	-.0797705	-.0044171
informalit	1.237449	.5608151	2.21	0.027	.1382721	2.336627
grade1_6	-.0961182	.3811923	-0.25	0.801	-.8432415	.6510051
grad>6	.3223816	.5537686	0.58	0.560	-.7629848	1.407748
adumale	-.4499902	.1614998	-2.79	0.005	-.7665241	-.1334564
adufem	-.1143572	.1435611	-0.80	0.426	-.3957318	.1670173
child1	-.4222457	.2173459	-1.94	0.052	-.848236	.0037445
pcnlaborinc	-.0000979	.00051	-0.19	0.848	-.0010974	.0009017
credit	-.0903987	.2601091	-0.35	0.728	-.6002031	.4194058
pctlu	-.18181	.1096025	-1.66	0.097	-.3966269	.0330068
pcfarmsize	.4770455	.2369306	2.01	0.044	.0126701	.941421
dalwroad	-.0601834	.2916824	-0.21	0.837	-.6318705	.5115036
dmajormkt	-.2781562	.1642033	-1.69	0.090	-.5999887	.0436764
district	.7541826	.3422518	2.20	0.028	.0833813	1.424984
_cons	7.06024	.8319145	8.49	0.000	5.429717	8.690762

select						
sex_hh	.4468583	.2788756	1.60	0.109	-.0997279	.9934445
age_hh	-.0442555	.0107274	-4.13	0.000	-.0652807	-.0232302
informalit	.3844578	.4177115	0.92	0.357	-.4342417	1.203157
grade1_6	-.553555	.2601536	-2.13	0.033	-1.063447	-.0436634
grade>6	-.9782592	.3612846	-2.71	0.007	-1.686364	-.2701543
adumale	-.177102	.1098727	-1.61	0.107	-.3924485	.0382446
adufem	.0347363	.1154404	0.30	0.763	-.1915228	.2609953
child1	-.3591485	.1396549	-2.57	0.010	-.632867	-.0854299
child2	-.4268203	.1374276	-3.11	0.002	-.6961735	-.1574672
pcnlaborinc	-.0004481	.0003906	-1.15	0.251	-.0012136	.0003174
credit	.0955887	.2074489	0.46	0.645	-.3110036	.5021811
pctlu	-.0681635	.1109623	-0.61	0.539	-.2856456	.1493187
pcfarmsize	.0440944	.211573	0.21	0.835	-.3705809	.4587698
dalwroad	-.089931	.2188564	-0.41	0.681	-.5188816	.3390196
dmajormkt	-.0431771	.1224539	-0.35	0.724	-.2831823	.1968281
district	.5039816	.206085	2.45	0.014	.1000624	.9079008
_cons	2.814337	.6847403	4.11	0.000	1.472271	4.156404
mills						
lambda	1.455853	.7425822	1.96	0.050	.0004191	2.911288
rho	1.00000					
sigma	1.4558533					
lambda	1.4558533	.7425822				

(e) Heckman selection model -- two-step estimates (regression model with sample selection)

Number of obs	= 205
Censored obs	= 128
Uncensored obs	= 77
Wald chi2(30)	= 60.39
Prob > chi2	= 0.0004

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lnpcsinc						
sex_hh	.9924145	.5939544	1.67	0.095	-.1717148	2.156544
age_hh	.0011029	.016543	0.07	0.947	-.0313207	.0335265
informalit	.2208653	.702102	0.31	0.753	-1.155229	1.59696
grade1_6	.4296321	.369619	1.16	0.245	-.2948078	1.154072
grade>6	.0685019	.5329459	0.13	0.898	-.9760529	1.113057
adumale	-.4832896	.2079619	-2.32	0.020	-.8908875	-.0756917
adufem	-.243042	.1645369	-1.48	0.140	-.5655285	.0794444
child1	.2432384	.211624	1.15	0.250	-.1715371	.6580139
child2	-.4949872	.2015492	-2.46	0.014	-.8900165	-.0999579
credit	-.0557708	.3526303	-0.16	0.874	-.7469134	.6353719
pctlu	-.0104015	.1370067	-0.08	0.939	-.2789298	.2581267
pcfarmsize	.2697203	.3512442	0.77	0.443	-.4187056	.9581462
dalwroad	-.175192	.4873922	-0.36	0.719	-1.130463	.7800791
dmajormkt	.42189	.2799683	1.51	0.132	-.1268378	.9706177
district	-.2126448	.343171	-0.62	0.535	-.8852476	.4599579
_cons	6.282243	1.019403	6.16	0.000	4.284249	8.280237
select						
sex_hh	-.8058813	.2857116	-2.82	0.005	-1.365866	-.2458969
age_hh	-.0162305	.0109468	-1.48	0.138	-.0376859	.0052249
informalit	-.4049807	.4398152	-0.92	0.357	-1.267003	.4570413
grade1_6	.0467474	.2624186	0.18	0.859	-.4675836	.5610783

```
    grade>6 |   .3039309    .375983     0.81   0.419    -.4329823     1.040844
    adumale |    .238722   .1178647     2.03   0.043     .0077115    .4697325
     adufem |  -.0023533   .1221499    -0.02   0.985    -.2417627    .2370562
     child1 |   -.0591541   .1422579    -0.42   0.678    -.3379744    .2196663
     child2 |    .0658236    .14157      0.46   0.642    -.2116485    .3432956
pcnlaborinc |  -.0013602   .0006736    -2.02   0.043    -.0026805   -.0000399
     credit |    .3888218   .2131011     1.82   0.068    -.0288486    .8064922
      pctlu |    1.268065   .6606185     1.92   0.055    -.0267232    2.562854
 pcfarmsize |  -.3259585   .2241341    -1.45   0.146    -.7652533    .1133364
   dalwroad |  -.5095666   .2659394    -1.92   0.055    -1.030798    .0116652
  dmajormkt |  -.3420643   .1467384    -2.33   0.020    -.6296664   -.0544623
   district |    .5051344   .2438388     2.07   0.038     .0272192    .9830496
      _cons |    1.143395   .7048142     1.62   0.105    -.2380151    2.524806
-------------+----------------------------------------------------------------
mills        |
     lambda |   -1.371778   .7719439    -1.78   0.076     -2.88476    .1412044
-------------+----------------------------------------------------------------
         rho |   -0.95851
       sigma |  1.4311584
      lambda | -1.3717779   .7719439
------------------------------------------------------------------------------
```

Determinants of Rural Households Off-farm Employment Participation and Income: Evidence from Rural Tigray
Household Questionnaire

Woreda_____
Tabia_____
Kushet_____
Household head name_____
Respondent name_____
Household ID.no._____

1. Preliminary household head information

Age of the household head	Gender of the household head 0=female 1=emale	Marital status of the hh head 1.single 2.married 3.widowed/separated	How many minutes does it take for you to travel on foot to			
			Nearest major road	Nearest Local market	To the major market	To DA office

2. Off-farm employment participation and Income (for each household member)

2.1. Can you tell me the most important activities your family members have done in the last 12 months (from Tri 2003- Tahsas2004) in terms of earning money or goods for themselves or for the household and to survive from day to day?

Id no.	name	(Tri 2003-Tahsas2004)			Off-farm employment activities
		Age	Sex 0=female, 1= male	Education /Years of schooling	
01					
02					
03					
04					
05					
06					
07					
08					

Legend: Off-farm Employment Activities

1= working for wage in non-agricultural activities eg: in mine/ shop/factory/construction work.
2= non- family agricultural activities /wage employed (agriculture)
3 = making hand crafts for sale
4= selling goods or services (trade)
5= cleaning shoes
6= non-agricultural family enterprise (shop, local beverages, tea, food selling etc)
7=regular salaried employment
8=begging
9= collecting fire wood/charcoal for sale
10= carpentry
11=(tailor, barber, hair dressing) for money
12= stone /sand collection for sale
13= petty trade
14= wild fruit selling
15= other non agriculture activities specify_____
88=N/A

2.2 Off-farm earnings

Please provide details of earnings from working on the following activities. Exclude earnings from farm products produced by the household.

s/no	Type of activity	How many months does the hh member participated in this activity(Tri2003-Tahsas2004)	How many days per month does the hh member worked on this activity	How much does paid per day
	Work for wages			
1	Agricultural wage work			
2	Casual /non-agricultural wage work			
3	Salaried/regular wage work			
4	Food/cash-for work			
	Business/self employment income		Earnings(Birr)	Costs(birr)
5	earnings from trading including animals and grain selling			
6	Earnings from processed food/alcohol			

7	earnings from handcrafts (sliver ironsmith, pottery, waving, mat making etc)			
8	earnings from carpentry, iron monger, etc			
9	earnings from services (tailor, barber, hair dressing ,other traditional etc			
10	Charcoal and fuel wood selling			
11	Stone and sand collection			
12	Wild fruit selling			
13	Petty trade			
14	Others specify			

In which season does your household involve in off-farm activities?_____
Why does your household participate in off-farm activities?_____
For what purpose does your household spent the income earned from off-farm sources?_____

3. Transfers and remittances (off-farm non labor income)

I am going to ask you some questions about money or goods that people sends or give you.

s/no	Source of money/goods	Have any from your family Received income from this source yes=1,No=0	What is the total value (cash and in kind) received in the last 12 months	
	Transfers from GO/NGO		Cash	In kind
1	Retirement pension			
2	Food /cash aid			
3	Religious organization			
4	Charity groups/NGOs			
	Transfers and remittances from other households			
5	Individuals live outside the household (eg family or friends)			
	Earnings from assets and savings			

6	Interest from savings			
7	Rent from property or other assets			

4. During the last 12 months, have you or any other members of the household give money or goods to support others?_____ (0= no,1=yes)
IF yes how much (Birr)_____

5. Approximately how much birr does the household have in formal/informal savings?_____

6: Access for productive safety net: public work and direct support
6.1. Was any member of household registered as a beneficiary of PSNP in the past 12 months (Tir 2003 - tahsas 2004)? _____(Yes=1 , No=0)

6.1. Was any member of household registered as a beneficiary of direct support in the past 12 months? _____(Yes=1, No=0)
If response to question 6 is yes fill this table

	Number of persons participate (Tri2003-Tahsas2004)	How much did the hh earn From this source(birr)
Food for Work/Cash for work		
PSNP direct support		

7. Expenditures

7.1Expenditure on inputs (Tri 2003-Tahsas2004)

Item	Unit	QtyPurchased	Price/unit	Total exped.
Seeds				
Fertilizer:				
Herbicide/ Pesticide				
Tools/equipment				
Hired oxen				
Animal salt				
Animal medicine				
Animals bought				
Others specify				

7.2Monthly Household Consumption Expenditures

commodity	unit	Qty consumed (own produced)	Qty consumed (Purchased)	Price	Own produced value	Purchased value
Teff						
Wheat						
Sorghum						
Bean						
barely						
Finger millet						
Millet						
Faba bean						
Abiciniya pea						
Chick pea						
Field pea						
Len seed						
Nug seed						
chicken						
Butter						
Other						

7.3 Weekly Household Consumption Expenditures

commodity	unit	Qty consumed own produced	Qty consumed (Purchased)	Price	Own produced value	Purchased value	Total weekly Expenditure
potato							
tomato							
onion							
egg							
milk							
sugar							
oil							
pepper							
salt							
coffee							
Soap/ Omo							
fuel							
others							

7.4 Yearly Household Consumption Expenditures

commodity	unit	Qty consumed (Purchased)	Price	Purchased value	Total annual Expenditure
meat					
shoes					
Blanket/bed sheet, umbrella etc					
Battery,radio,tape,tv					
Health expnd					
furniture					
Travel expend					
Land tax					
School fee, book					
church					
beggar					
House construction					
ceremonies					

8. Livestock holding and market participation during Tri2003- Tahsas2004 production year.

Type of livestock	Total Livestock owned	Total sold	Consumed by the hh	Price/unit	Total value
Oxen(#)					
Bulls(#)					
Calves(#)					
Cows(#)					
Heifers (#)					
Sheep(#)					
Goat(#)					
Horse (#)			N/A		
Mule (#)			N/A		
Donkey(kg)			N/A		
Poultry(#)					
Bee hive(#)			N/A		
other					

8.1Livestock by Products

Type of livestock	unit	Total product obtained	Total sold in kg(number)	Total consumed	Price/unit	Total value
Milk						
Butter						
Honey						
Egg						
Skin/hide						
Wax						

8.2 How much Birr you spent for LS feed_____
Vaccination/medicine_____
Shelter_____

9. Crop income: from (Tri 2003-Tahsas2004**)**

Crop type	Area in (tsmdi)	Yield(kg)	Crop sold(kg)	Crop consumed(kg)	Stored(kg)	Crop residue (donkey load)	Price/donkey load
Teff							
wheat							
Barely							
wheat							
maize							
Sorghum							
Millet							
Oats							
bean							
pea							
Lentil							
Linseed							
Vetch							
Tomato Potato Onion Garlic Pepper Lettuce Schrage Fruits others							

9.1 Total labors hired for agricultural production from Tri 2003 up to Tahsa 2004_____

9.2 Total hired labor cost (Birr) for agricultural production from Tri 2003 -Tahsas 2004_____

10. Productive assets

Assets	Total owned (Tri 2003-tahsas2004)	Price/unit 2003/4	Total value 2003/4
Plowing tools			
Traditional sickles			
Modern sickles			
Peaxe			
Rak			
Axe			
Misar			
Gojomo			
Spad			
Traditional beehive			
Modern beehive			
Stina			
Motor			
Family drip			
Other, specify			

11. Land ownership

Type of land	Owner cultivated (tsimidi)	Rented out (tsimdi)	Rented in (tsimdi)
Low quality			
Medium quality			
High quality			
irrigated			

12. Other livelihood sources

Source	Days worked/yr	Daily wage rate	Annual income	Rank the first three
Hiring out oxen				
Hiring out equine cart				
Hire out labor				
PSNP				
Hair making				
Sale of fire wood	N/A	N/A		
Wild fruit gathering	N/A	N/A		
Grain trading	N/A	N/A		
House rent income	N/A	N/A		
Migrant income	N/A	N/A		
Remittance income	N/A	N/A		
Emergency food Aid	N/A	N/A		
Sale of Handicraft	N/A	N/A		
Sale of beverages, tea ,coffee	N/A	N/A		
Assistance from relatives	N/A	N/A		
Bride price	N/A	N/A		
Petty trade	N/A	N/A		
Livestock trading	N/A	N/A		
Grain mill	N/A	N/A		
Sand collection	N/A	N/A		
Stone collection	N/A	N/A		
Other				

13. Participation in local institutions and organization

Local organizations	Isyour family Member (Yes=1 No=0)	Committee member (Yes=1 No=0)
Farmer organization		
Youth association		
Women association		
Multipurpose cooperative		
Saving and credit cooperative		
Local administration		
Equb /Idir		

14. Information on media exposure and communication

	2003/04, (1=.yes 0=no)
Frequency of extension contact per year	
Have you ever been a model farmer?	
Listen radio on agricultural agenda	
Have you ever been an agricultural cadre	
Host of demonstration?	
Attended any farmers' demonstration/ field day arranged by development agent?	

15. Availability of Credit Services during the last 12 months

15.1. Did you get credit services (Tri 2003 –Tahsas2004)?_____(1. = Yes 2. =No)

Purpose	amount	Source of loan

Legend: Purposes 1.for basics necessity goods, 2. for Medicine, 3. to teach my children, 4. to purchase improved seeds 5. to purchase fertilizer 6. to purchase animals 7. To petty trade , 8. to pay other loans, 9. to minimize risk during crop failure 10. Other specify

Sources: 1. Dedebit 2. Cooperatives 3. NGOs 4. Local money lender 5. Relatives

15.Approximately how much the household has in formal (formal) saving?_____